Hovgaard

SCIENCE ABSTRACTS

SECTION A

PHYSICS.

Vol. 39 FEBRUARY 25, 1936 No. 458
(Abstracts 358-918)

EDITED AND ISSUED MONTHLY BY
THE INSTITUTION OF ELECTRICAL ENGINEERS.
Savoy Place, Victoria Embankment, London, W.C.2.
IN ASSOCIATION WITH
THE PHYSICAL SOCIETY,
THE AMERICAN PHYSICAL SOCIETY,
THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AND
L'ASSOCIAZIONE ELETTROTECNICA ITALIANA.

SOLD BY
E. & F. N. SPON, LTD., 57 HAYMARKET, LONDON, S.W.1;
ENGINEERS BOOK SHOP, 168 EAST 46TH STREET, NEW YORK.

Price, Single Numbers, 3s. 6d.
Annual Subscription, 35s., including the Yearly Index.
Annual Subscription for both Sections, 60s.
Copyright.

ABSTRACTORS

G. E. Allan, D.Sc.
R. F. Allen, B.Sc.
C. B. Allsopp, M.A., Ph.D.
J. P. Andrews, D.Sc., F.Inst.P.
W. R. Angus, M.A., B.Sc., Ph.D.
N. F. Astbury, M.A.
R. d'E. Atkinson, M.A., Ph.D.
E. H. W. Banner, M.Sc., M.I.E.E., F.Inst.P.
C. O. Bannister, A.R.S.M.
S. G. Barker, Ph.D., F.Inst.P.
H. Barrell, B.Sc., A.R.C.S., D.I.C.
F. S. Barton, M.A., B.Sc., F.Inst.P., A.M.I.E.E.
G. E. Bell, B.Sc., A.Inst.P.
J. E. Bennett, M.A., A.M.I.E.E.
P. H. Bigg, B.Sc.
N. M. Bligh, A.R.C.Sc., A.I.C.
F. J. Brislee, D.Sc., F.I.C.
H. L. Brose, D.Sc., D.Phil., M.A., F.Inst.P.
H. M. Browning, M.Sc., Ph.D., F.Inst.P.
J. M. Bruckshaw, M.Sc.
L. G. Carpenter, B.A., B.Sc.
F. C. Champion, M.A., Ph.D.
L. V. Chilton, M.A., F.Inst.P.
J. S. Clark, B.Sc., A.R.C.S., D.I.C.
C. J. B. Clews, B.Sc., Ph.D., A.Inst.P.
J. E. R. Constable, Ph.D., M.A., B.Sc.
K. M. Constable, B.A., B.Sc.
A. Daniell, M.A., D.Sc.
L. Essen, B.Sc.
M. A. Evershed, F.R.A.S.
J. Ewles, M.A.
D. H. Follett, M.A., F.Inst.P.
R. C. Fox, Ph.D. B.Sc.(Eng.)., A.M.I.E.E.
A. E. M. Geddes, M.A., D.Sc.
W. H. George, M.Sc., Ph.D., F.Inst.P.
H. F. Gillbe, Ph.D., B.Sc.
E. Griffiths, D.Sc., F.R.S.
L. Hartshorn, D.Sc., A.R.C.S., D.I.C.
A. Harvey, Ph.D., B.Sc., F.Inst.P.
H. H. Hodgson, Ph.D., M.A., B.Sc.
E. J. Irons, Ph.D., F.Inst.P.
W. Jevons, D.Sc., Ph.D.
T. I. Jones, M.Sc., A.R.C.S., D.I.C.
J. Kaye, B.Sc.
J. E. Keyston, B.Sc., D.Phil.
E. Lancaster-Jones, M.A.
R. Lang, B.Sc., Ph.D., A.Inst.P.
A. S. C. Lawrence, Ph.D.
B. J. Leggett, M.R.C.S.
T. M. Lowry, D.Sc., F.R.S.
A. J. McConnell, D.Sc., F.T.C.D.
T. L. MacDonald, M.A.
G. C. McVittie, M.A., Ph.D., F.R.A.S.
A. S. D. Maunder, F.R.A.S.
A. C. Menzies, M.A., D.Sc.
W. E. Perry, B.Sc.
R. W. Powell, B.Sc.
F. I. G. Rawlins, M.Sc., F.Inst.P.
R. S. Read, M.A., B.Sc.
W. A. Richardson, B.A., D.Sc., B.Sc.(Eng.).
J. E. Roberts.
E. Rushton, B.Sc.
C. A. Silberrad, B.A., B.Sc.
F. Simeon, D.Sc.
H. J. H. Starks, Ph.D., A.Inst.P.
J. J. Stewart, M.A., B.Sc., M.I.E.E.
W. S. Stiles, Ph.D., B.Sc.
J. Thewlis, M.Sc.
A. M. Thomas, B.Sc., A.Inst.P.
J. S. G. Thomas, D.Sc.
G. F. P. Trubridge, M.Sc., Ph.D.
P. Vigoureux, M.Sc., A.C.G.I., D.I.C., A.M.I.E.E.
J. W. T. Walsh, M.A., D.Sc., M.I.E.E.
W. H. Ward, B.Eng.
C. E. Webb, B.Sc., A.C.G.I., D.I.C., A.M.I.E.E.
F. J. Wilkins, M.Sc., Ph.D.
A. Wilkinson, B.Sc.
A. B. Wood, D.Sc.
L. A. Woodward, B.A., Ph.D.

A star (*) indicates that the Abstract deals with Apparatus and Instruments.

FEBRUARY, 1936.

GENERAL PHYSICS.

ADSORPTION.

358. Adsorption of Hydrogen and Deuterium on Copper at Low Pressures. R. A. Beebe, G. W. Low, Jr., E. L. Wildner and S. Goldwasser. *Am. Chem. Soc., J.* 57. *pp.* 2527–2532, *Dec.*, 1935.—Very definite and complex differences have been found between the adsorptions of light and heavy hydrogen on active copper at low pressures (0 to 2 mm.). At − 78° the rate of adsorption is less for deuterium than for hydrogen, but equal amounts of the two isotopes are adsorbed at equilibrium. In the temperature interval 0 to 125° the ratio H_2/D_2 adsorbed undergoes an inversion, hydrogen being more strongly adsorbed at the lower temperatures and less strongly at the higher temperatures. The differential heats of adsorption have been measured by a direct calorimetric method, and are identical for the two isotopes within the limits of experimental error. The early rate of adsorption of hydrogen at − 78° is autocatalytic. The same is true for deuterium. AUTHORS.

359. Adsorption of Gases at Virgin Salt Surfaces. F. Durau and A. Horn. *Zeits. f. Physik*, 98. 3–4. *pp.* 198–226, *Dec.* 14, 1935.—A method is described whereby salts can be freed from solid and gaseous impurities, while a process has also been devised for pulverising degassed salts by fusion in a high vacuum or in a selected gas, whereby the salt does not come into contact with air between the fusion period and the pulverisation. In the actual experiments, N_2 is adsorbed at surfaces of NaCl, $CdCl_2$ and $NaNO_3$, so that the adsorbed gas can be removed at room-temperatures. The adsorption of N_2 at pressures below 1 mm. Hg and at 20° C. is so small, that only an extremely small fraction of the surface is covered with nitrogen. When the salt is powdered in presence of the adsorbing gas, then the adsorption takes place at the instant of surface production. H. H. Ho.

360. Influence of Platinum on the Adsorption Properties of Charcoal in Electrolyte Solutions. S. Lewina, A. Frumkin and A. Lunew. *Acta Physicochimica*, 3. 4. *pp.* 397–412, 1935. *In German.*—It is shown, that the effect of Pt on the adsorption properties of charcoal, which has been observed at platinised charcoal in an atmosphere of H_2, may be reproduced by means of simple mechanical contact of smooth metallic Pt with charcoal in electrolyte solutions. The dependence of the amount of alkali, which is adsorbed at unplatinised charcoal in an atmosphere of H_2, upon the amount of added platinised charcoal, has been determined. It is shown that the adsorption of alkali by charcoal, on shaking with smooth metallic Pt in an atmosphere of H_2, can be increased when a fresh Pt surface is introduced into the system, and that a Pt surface, which has attained a stationary adsorption state, loses the capacity for further influence of the adsorption properties. The conclusion is consequently drawn, that the Pt in platinised charcoal acts electrochemically upon the remainder of the charcoal surface by distribution of its potential, and that the intermediate adsorption states, in which the limiting

adsorption value is not attained, are to be explained by the poisoning of the Pt present. H. H. Ho.

See also Abstracts 479, 482, 625.

ATOMIC AND MOLECULAR STRUCTURE.

361. Structure of Atomic Nuclei. H. A. Wilson. *Roy. Soc., Proc.* 153*A*. *pp.* 493–504, *Feb.* 1, 1936.—The energies of formation of several atoms, from neutrons and protons, are calculated from nuclear reaction energies. It is suggested that the energies of formation may be supposed due to the formation of bonds or connections between the neutrons and protons. Arrangements of the neutrons and protons and bond energies are found which give the correct energies of formation. The observed reactions may be explained by means of the assumed nuclear arrangements or constitutions and the bond energies. AUTHOR.

***362. Radioactivity by Bombardment. J. J. Livingood.** *Electronics*, 8. *pp.* 421–423, *Nov.*, 1935.—Account of the apparatus used by Lawrence and Livingston for the artificial disintegration of elements by ions produced in a discharge tube and accelerated in a uniform magnetic field by a h.f. oscillator. The results already obtained are described and speculation is made regarding future developments. F. C. C.

363. Disintegration of Nitrogen by Neutrons. G. Kirsch and F. Rieder. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 7–8. *pp.* 383–392, 1935.—Wilson chamber photographs of the disintegration of N by neutrons show that two processes occur, each of which is connected with the capture of the neutron. In one case ^{11}B is produced, with the emission of an α-particle. The second process, which is much less frequent and which is due chiefly to fast neutrons, probably consists in the production of ^{14}C, accompanied by proton emission. Energy considerations lead to the view that this product has a long life, so that its β-activity may easily have escaped detection. W. E. P.

364. Possibility of Disintegration of the Elements A to Mn with Po α-Particles. J. Schintlmeister and E. Föyn. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 7–8. *pp.* 409–418, 1935.—The work of Schintlmeister and Stetter on the disintegration of light elements up to Cl with α-particles from Po is extended to Mn (excluding Cr). Disintegration effects are only observed with certainty in the case of K. If disintegration occurs in the case of the other elements the yield must be less than about $0{\cdot}2$ per 10^6 α-particles. The stability of the nuclei of these elements is discussed with reference to their possible structure. J. E. R. C.

365. Disintegration of Aluminium. E. Steppan. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 7–8. *pp.* 456–474, 1935.—The protons emitted from Al at right angles to the α-particles with which it is bombarded are examined by allowing the protons to fall obliquely on a photographic plate. Po is used as a source of α-particles. The Al used has an equivalent thickness of 5 mm. of air. From a statistical examination of the records the disintegration particles are resolved into eight groups having ranges of 17, 22, 25, 28, 41, 46 and 50 cm. at 15° C. The groups are connected in pairs, a certain minimum energy being necessary to excite each pair. The characteristic minimum energies are $3{\cdot}5$, $4{\cdot}2$, $4{\cdot}6$ and $5{\cdot}2 \times 10^6$ eV. No evidence of a maximum value of the exciting energy is obtained. While the observed constancy of range of the particles indicates a resonance effect, in at least one case (the 17 cm. group) the other observations discount the possibility of resonance effects. The two energy emissions

corresponding to the two members of each pair are given as 0 and $2{\cdot}2 \times 10^6$ eV. J. E. R. C.

366. Emission of γ-Quanta on the Disintegration of Lithium by Rapid Protons. K. D. Alexopoulos. *Zeits. f. Physik*, 98. 5–6. *pp.* 336–341, *Dec.* 23, 1935.—The production of γ-quanta on the disintegration of Li by protons of high energy (450 ekV) is affirmed. At lower energies there are contradictory observations. To examine this question Li was bombarded with a proton current of 10 mA and 140 ekV. The number of disintegrations of Li thereby attained amounted to 350 per sec. By measurements with a Geiger-Müller counting tube no γ-quanta were indicated. This holds also for the case in which a sheet of lead 6 cm. thick was inserted between the irradiated preparation and the counting tube. All the observed range groups of the α-particles can be well explained without the assumption of an emission of γ-quanta. J. J. S.

367. Excitation Function of Lithium under Proton Bombardment. M. Ostrofsky, G. Breit and D. P. Johnson. *Phys. Rev.* 49. *pp.* 22–34, *Jan.* 1, 1936.—The yield of α-particles in the bombardment of Li with protons is calculated for different depths of the " potential well." By using the part of the incident wave having an angular momentum $L = 1$, with a radius $0{\cdot}35 \times 10^{-12}$ cm., a " potential well " about $2{\cdot}5$ eMV deep is needed, agreeing with approximate estimates of this depth from nuclear binding energies. The shape of the excitation curve and the absolute value of the cross-section can be varied by changing the depth and width of the " well." The position of stationary and resonance levels is important for the shape of the excitation curve. The effect of the decay of the incident wave inside the nucleus is found to be small in the present case. The asymptotic form of the dependence of the collision cross-section on velocity at low velocities is calculated. Estimates of the theoretically expected variation of the yield with velocity are made for $Li^7 + H^2$. A correspondence between different nuclear reactions is established by means of which calculations for one reaction can be used to obtain yields for another reaction with a corresponding " well," and this, for the quantitative representation of the α-particle reaction is compared with the mass of Be^8. Both requirements can be fitted by attributing the α-particle reaction to $L = 0$ and the formation of Be^8 from Li^7 to the addition of a proton into a p level. N. M. B.

368. Angular Distribution of the Products of Artificial Nuclear Disintegration. J. Giarratana and C. G. Brennecke. *Phys. Rev.* 49. *pp.* 35–40, *Jan.* 1, 1936.—Measurements were made of the angular distribution of the α-particles emitted during the disintegration of Li^7 by fast protons. The protons were generated in a low voltage arc and accelerated down a three-section vertical tube by potentials obtained from a rectifying and doubling system. The bombarding beam was analysed by an electromagnet, defined by a series of circular slits, and allowed to impinge on the target in a special chamber designed to permit observation of the particles at positions spaced by 15° in the plane of the beam. The α-particles were recorded by an ionisation chamber which actuated a linear amplifier and oscillograph. Readings taken at three voltages between 200 and 240 kV indicate that within the limits of experimental error, estimated as approximately 8 %, emission of α-particles is random in direction. AUTHORS.

369. Disintegration of Boron. D. Roaf. *Roy. Soc., Proc.* 153*A*. *pp.* 568–576, *Feb.* 1, 1936.—A Wilson expansion chamber has been built

for use with boron tri-fluoride and with it the recoils from the disintegration of B_5^{10} by neutrons have been photographed and their energy measured. The energy released in the reaction $B_5^{10} + n_0^1 = Li_3^7 + He_2^4$ is found to be $1{\cdot}50 \pm 0{\cdot}05 \times 10^{-3}$ units of atomic mass and a correction to the B_5^{10} mass has been made ($B^{10} = 10{\cdot}0136 \pm 0{\cdot}0014$). The effective B_5^{10} -neutron cross-section is estimated at $1{\cdot}6 \times 10^{-21}$ sq. cm. Most of the disintegrations were caused by neutrons of energy less than 2×10^4 eV but one was observed due to a neutron of energy greater than 1×10^5 eV. AUTHOR.

370. Isotopic Constitution of Iron. J. de Gier and P. Zeeman. *K. Akad. Amsterdam, Proc.* 38. 9. *pp.* 959–961, 1935.—The existence of an Fe isotope 57, with the possible presence of 58 has been reported by Aston [see Abstract 1904 (1935)]. With improved technique, a mass spectrum examination, using very pure iron carbonyl, showed lines corresponding to isotopes of mass number 54, 56, 57, and 58 with estimated relative abundances 6·5, 90·2, 2·8, and 0·5 respectively. N. M. B.

371. Mass Ratio of Hydrogen and Deuterium from Band Spectra. W. W. Watson. *Phys. Rev.* 49. *pp.* 70–71, *Jan.* 1, 1936.—The size of the several corrections to the observed, apparent B_e constants of the usual rotational energy expression in order to obtain " true " B_e values is calculated for some diatomic hydride and deuteride molecules. It is shown that the corrections arising from the uncoupling terms due to the interaction of certain electronic levels (van Vleck, Mulliken) and from the inclusion of the interactions between nuclear and electronic motions (Kronig) are by far the most important for the molecules considered. The calculations show that, assuming 1·0081 to be the mass of the H atom, the mass of D has to be greater than the 2·01423 value given in a number of recent articles. A value close to Aston's latest, 2·0148, is indicated. AUTHOR.

372. Mass Ratio of the Lithium Isotopes from the Spectrum of Li_2. G. M. Almy and G. R. Irwin. *Phys. Rev.* 49. *pp.* 72–77, *Jan.* 1, 1936.—It is shown from a study of the $^1\Sigma \rightarrow {}^1\Sigma$ Li_2 band system that the relative masses of the two isotopes of Li as calculated from the observed isotope effect in each of the two lowest states of Li_2 is in excellent agreement with the mass ratio obtained by other precise methods. Various methods of treating the data lead consistently to the conclusion that the mass-coefficient ρ is $1{\cdot}04077 \pm 0{\cdot}00004$ and that the mass ratio is $1{\cdot}16640 \pm 0{\cdot}00016$. This result disagrees with that of McKellar and Jenkins who, from a less extensive study of the $^1\Pi \rightarrow {}^1\Sigma$ system of Li_2, concluded that the mass ratio was $1{\cdot}1678 \pm 0{\cdot}0008$, a result which cast suspicion upon the band spectrum method of determining relative atomic masses. There has also been found a small but definite electronic isotope shift : $\nu_e^i - \nu_e = -0{\cdot}064 \pm 0{\cdot}010$ cm.$^{-1}$. AUTHORS.

373. Absorption of Neutrons in Water, Paraffin and Carbon. L. Arzimowitsch, I. Kurtschatow, G. Latyschew and W. Chromow. *Phys. Zeits. d. Sowjetunion,* 8. 4. *pp.* 472–486, 1935. *In German.*—Experiments are described whereby the γ-radiation resulting from the passage of neutrons through paraffin, water and carbon, due to absorption of the slow neutrons by the atomic nuclei, is measured. The cross-section, σ, for capture, and its relation to the energy of the neutron, depend on the presence or absence of a stable level $1p$ in the resultant nucleus in addition to the fundamental level $1s$. If the level $1p$ exists σ for slow neutrons of energy of a few volts is of the order 10^{-25} cm.^{2} ; if it does not σ is very

small with a maximum of about 10^{-29} cm.^{2} for neutrons of a few million volts energy. The values ($\times 10^{25}$) for σ_o and σ_o (3·10) correspond to the first case, as also that of $\sigma_H(2\cdot5)$. To avoid conflict with Chadwick and Goldhaber's result ($\sigma_H = 10^{-29}$) [see Abstract 4371 (1934)] it must be assumed that the force between a neutron and a proton necessitates a stationary level $1p$. The absorption coefficients, $\mu \times 10^2$, of slow neutrons in H_2O, paraffin and C are approximately 2·7, 3·5 and 1·5 respectively. [See Abstract 3211 (1935).] C. A. S.

374. Slow Neutrons. P. I. Lukirskij and T. V. Careva. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.*, 3. *pp.* 393–396, 1935.—Describes experiments carried out with neutrons produced by a Rn-Be source and slowed down initially by water or paraffin wax. The activity of a silver target was measured when paraffin wax 10 cm. thick surrounding it was at room-temperature and when it was at liquid-air temperature. No increase or activity due to cooling of the wax was observed. Experiments were then made with thicknesses of wax 1·7, 1·0 and 0·8 cm. surrounding the target and in each case an increase of activity corresponded with the cooling of the wax, the increase being greater the smaller the wax thickness. The experiments prove the existence of the temperature effect and confirm the suggestion that as in the first experiment the absorption of neutrons of thermal velocities may compensate the increase of the effectiveness of neutrons with decreasing temperature. W. E. P.

375. Neutrons from the Disintegration of Deuterium by Deutons. T. W. Bonner and W. M. Brubaker. *Phys. Rev.* 49. *pp.* 19–21, *Jan.* 1, 1936.—The excitation functions for the emission of neutrons from the two reactions ${}_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_0n^1$ and ${}_4Be^9 + {}_1H^2 \rightarrow {}_5B^{10} + {}_0n^1$ are investigated in the energy range from 0·5 to 0·9 eMV. In this interval the yield of neutrons from a $H_3{}^2PO_4$ target increases nearly linearly with the bombarding energy while the yield from a Be target increases nearly exponentially. At 0·9 eMV three times as many neutrons were observed from the Be target as from the $H_3{}^2PO_4$ target. At the lower voltage of 0·5 eMV only 1/3 as many neutrons came from the Be as from the $H_3{}^2PO_4$. The neutrons from deuterium were found to be nearly homogeneous in energy with a maximum of 2·55 eMV when they are observed at right angles to the direction of the incident 0·5 eMV deutons. The energy of the disintegration is $3\cdot21 \pm 0\cdot13$ eMV. AUTHORS.

376. Neutrons of Thermal Energies. P. B. Moon and J. R. Tillman. *Roy. Soc., Proc.* 153*A*. *pp.* 476–492, *Jan.* 1, 1936.—Using a Geiger counter, the radioactivity induced in various elements (Cu, V, Dy, Ag, Rh, I, B) is shown to increase by amounts up to 50 % as the temperature of paraffin wax surrounding the element is lowered to 90° K. The effect is ascribed to the presence of neutrons of thermal energies. The apparent absorption of neutrons by I and by Ag depends greatly upon the nature of the detector used to measure the intensity of the transmitted beam, being greatest when the detector is the same element as the absorber. An absorber of Cu, on the other hand, shows only very slight selectivity. The interpretation of the results is not straightforward and is discussed in detail. F. C. C.

377. Dependence of Interatomic Distance on Single Bond-Double Bond Resonance. L. Pauling, L. O. Brockway and J. Y. Beach. *Am. Chem. Soc., J.* 57. *pp.* 2705–2709, *Dec.*, 1935.—Using experimental values for C-C bonds, a function is plotted showing the dependence of interatomic distance on bond character for single bond-double

bond resonance. This function is tested with data for other bonds, and used in the discussion of the electronic structure of molecules containing conjugated double or triple bonds or aromatic nuclei and of molecules containing C-Cl bonds adjacent to double bonds. The dependence of bond angles on single bond-double bond resonance is discussed. Values of C-C bond distances in polynuclear aromatic hydrocarbons are predicted and compared with the existent experimental data. AUTHORS.

378. System of Masses of Light Atoms Deduced from Nuclear Reactions. L. Isakov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 7. *pp.* 301–304, 1935. *In English.*—Owing to uncertainties in the mass-spectrograph values of the ratio He : O, experimental data were collected for 19 nuclear reactions, and a system of atomic masses was obtained after correcting for uncertainties. Results agree closely with mass-spectrograph data, in most cases to the fourth or fifth decimal place, discrepancies lying within probable error. Hence the mass and energy equivalence principle for elementary transmutation processes is regarded as verified within the limits of transmutation energy determinations. The case of the Be atom is discussed in some detail. N. M. B.

379. Agreement between Nuclear Energy Differences and Masses of Light Elements. L. Cartan. *Comptes Rendus*, 201. *pp.* 1363–1365, *Dec.* 23, 1935.—The following revised atomic masses have been deduced from recent work, combined with results deduced from band spectra: ^{1}n 1·0083 ± 0·0005; ^{1}H 1·0081 ± 0·0001; ^{2}H 2·0143 ± 0·0002; ^{4}He 4·0034 ± 0·0003; ^{6}Li 6·0166 ± 0·0010; ^{7}Li 7·0167 ± 0·0012; ^{9}Be 9·0152 ± 0·0010; ^{10}B 10·0141 ± 0·0009; ^{11}B 11·0109 ± 0·0010; ^{12}C 12·0037 ± 0·0010. C. A. S.

380. Formation of Mercury Molecules. F. L. Arnot and J. C. Milligan. *Roy. Soc., Proc.* 153*A*. *pp.* 359–378, *Jan.* 1, 1936.—Diatomic molecular ions of Hg, appearance potential = 9·5 V, are observed for the first time by magnetic analysis of the ions produced in Hg vapour by electron impact. Pressure variation curves show that the molecular ions are produced by a secondary process and that the number produced is directly proportional to the first power of the filament emission. Various ionisations produced by increasing the energy of the electrons are discussed. The formation of molecules by attachment of excited atoms to normal atoms is shown to occur; this reconciles the chemical evidence of their non-existence and the band spectral evidence of their presence, because if the atoms are not excited the vapour may remain practically monatomic. W. R. A.

See also Abstracts 386, 593, 598, 601, 602, 648, 688, 689, 735, 750, 832, 837, 879.

COLLOIDS.

381. Viscosity of Sugar and Dextrin Solutions Containing Salts. J. H. C. Merckel. *Kolloid. Zeits.* 73. *pp.* 171–174, *Nov.*, 1935.—It is shown that the effect of salts on the viscosity of sugar and dextrin solutions is such that there is a quantitative relationship between the viscosities and the lyotropic numbers. [See Abstract 4792 (1935).] J. K.

***382. Capillary Viscometer. V. Z. Daneš.** *Kolloid. Zeits.* 73. *pp.* 174–181, *Nov.*, 1935.—A new form of capillary viscometer is described and illustrated, particularly useful in connection with colloid-chemical measurements, especially for anomalous liquids. Investigations are carried out with ammonium-oleate and Sirius-yellow sols. J. K.

***383. Structure and Viscosity of Lyophilic Sols. Part I. Gelatin Sols. N. Peskoff and S. Averbuch.** *Kolloid. Zeits.* 73. *pp.* 182–191, *Nov.*, 1935.—A new viscometer is described for use in connection with the complicated phenomena of thixotropy and aging of sols. The deviation of gelatin sols from the Hagen-Poiseuille law is put down to two factors, namely the internal structure and the orientation of the particles. Each factor influences in certain cases the properties of the sols. Additions of acid and alkali alter the viscosity and the elastic forces of gelatin sols, the former increasing up to certain limits while the latter decreases. The increase in viscosity by the addition of acid or alkali is explained as due to an electroviscosity effect, an increase in the degree of dispersion thus bringing about a relative increase in solvating solvent, the possible increase in degree of swelling and the extension of the micelles, which can be imagined as skeins at the isoelectric point. J. K.

384. Influence of Polarised Light on Colloidally Coloured Silver Halides. (Weigert Effect.) S. Čerdyncev. *Acta Physicochimica*, 3. 2–3. *pp.* 355–360; *Disc.*, 360, 1935. *In German.*—Silver halides illuminated with linearly polarised light are not only coloured but at the same time exhibit dichroism (Weigert). It has been shown that the various colours of AgCl are due to colloidal particles of different sizes and that the size of these particles are affected by light—long-wave light destroys these unstable particles while short-wave light ($\lambda \sim 500$ $\mu\mu$ for AgCl) increases their size. When the particles are viewed in a polarising microscope and the whole crystal illuminated with polarised light the colours of the particles change from green to blue as the eyepiece nicol is rotated 90°. The AgCl as a whole remains, however, isotropic. If the AgCl crystal is illuminated with ordinary light the particles disappear in the polarising microscope. It appears that there is an alteration of form under polarised light. A theoretical treatment of the phenomenon assuming the particles to be ellipsoids of rotation and following Gans' use of Mie's theory of the optics of colloidal solution is compared with the experimental results with satisfactory agreement. J. E.

***385. Air-Driven Spinning Top as Transparent Ultracentrifuge. J. W. McBain and C. M. O'Sullivan.** *Am. Chem. Soc., J.* 57. *pp.* 2631–2641, *Dec.*, 1935.—The air-driven spinning top is developed as a transparent convectionless ultra-centrifuge. The three types of instability of the air-driven rotor are described, with their causes and remedies. Means are given for measuring, increasing and controlling the speed of the top, with a discussion of the best materials of construction. Spinning top centrifuges are described in which it is possible to photograph the cell by transmitted light of any monochromatic wave length, visible or ultraviolet. Two different types of cells are described. Means are discussed for measuring and controlling the temperature gradient existing between the top and bottom of the cell. The present stage of the development of the instrument is described. AUTHORS.

See also Abstracts 450, 640.

CRYSTAL STRUCTURE AND PROPERTIES.

386. Atomic-Lattice Relationships. E. L. Feinberg. *Phys. Zeits. d. Sowjetunion*, 8. 4. *pp.* 407–415, 1935. *In English.*—An approximation of the metallic crystal by means of a space lattice formed by the ions, the inter-ion space being filled with the gas of free electrons, and

division of the crystal into the Wigner and Seitz spherically symmetrical cells, enables the inter-atomic distance which corresponds to the stable state of the crystal, expressed as the function of the valency z of the element to be determined. Thus the dependence on the valency is obtained: (1) of the atomic volume, explaining L. Meyer's atomic volume curve; (2) of the energy of such ionisation which deprives the atom of all its z valency electrons, this dependence also giving good coincidence with experimental data. [See following Abstract.] AUTHOR.

387. Application of Thomas-Fermi Method to Metallic Cohesion. E. L. Feinberg. *Phys. Zeits. d. Sowjetunion*, 8. 4. *pp.* 416–424, 1935. *In English.*—The present work shows in a purely analytical way that the energy of the crystal calculated on the basis of the Thomas-Fermi method, when expressed as a function of the interatomic distance, has no minima. This confirms the results of the numerical calculation of the energy curve, carried out independently of this work by Slater and Krutter, who, in spite of careful plotting of the curve, failed to reveal any minima. It means that the Thomas-Fermi method cannot explain the stability of the crystal lattice. [See preceding Abstract.] AUTHOR.

388. Transformation in the Copper-Gold Alloy Cu_3Au. C. Sykes and H. Evans. *Inst. of Metals, J.* 58 [30 *pp.*], 1936. *Advance Copy.*—The effect of the transformation in the alloy Cu_3Au on the electrical resistance, X-ray structure, and specific heat is investigated experimentally, and it is shown that the general character of the transformation is satisfactorily predicted by the Bragg-Williams theory of the formation of super-lattices by atomic rearrangement. The atomic rearrangement process involves first the formation of small nuclei having a relatively high degree of order. These nuclei then grow to a size approximating to that of the individual crystals, if a constant temperature is maintained. If, however, the alloy is continuously cooled before it attains equilibrium, two processes proceed simultaneously, the nuclei tend to grow, and at the same time the degree of order in the nuclei increases owing to the reduction in the temperature. The existence of such nuclei is not considered in the statical theory of super-lattices, so that it is not surprising to find that the theoretical predictions regarding the rate of relaxation into the equilibrium state are not in agreement with experiment. [See also Abstract 1197 (1935).] AUTHORS.

389. Lattice Distortion and Coercive Force in Single Crystals of Ni-Fe-Al. W. G. Burgers and J. L. Snoek. *Physica*, 2. *pp.* 1064–1074, *Dec.*, 1935. *In English.*—The phenomenon of precipitation hardening is examined magnetically and by means of X-rays in single crystals of Ni-Fe-Al, prepared by one-sided cooling from the melt. X-ray diagrams reveal 3 different types of change in the segregation of the γ-phase from the undercooled α-phase, *viz.*, the appearance of new lines corresponding to the γ-phase, formation of a superstructure in the α-phase during, or before, the segregation and line broadening due to lattice disturbances caused by the segregation. The results are in agreement with those of Glocker, except as regards line broadening. Marked broadening occurs in all cases where the coercive force differs appreciably from zero and also the type of broadening on the rising part of the curve is different from that on the falling part. An attempt is made to account for the discrepancies and the manner in which line broadening occurs is discussed. It appears that general broadening only sets in after the maximum coercive

force has been passed. Finally the bearing of the work of G. Wassermann on the subject is considered. H. J. H. S.

390. Distortion of β-Brass and Iron Crystals. C. F. Elam. *Roy. Soc., Proc.* 153*A*. *pp.* 273–301, *Jan.* 1, 1936.—Experiments on the distortion in tension of the body-centred cubic crystals iron (2 specimens) and β-brass (13 specimens) are described, and lead to the conclusion that there is no essential difference between them. Tables of spherical coordinates of distortion planes, direction of slip, slip bands, nearest crystal planes, and crystal directions are given. Although slip-bands agreeing with possible crystal planes, chiefly (110) and less frequently (112) planes, are usual, calculations of the distortion do not agree with slip on these planes throughout the extension. The direction of slip is usually, but not invariably, a (111) direction. It is suggested that the deformation does not take place by slip on any definite crystal plane, but that the distortion is brought about by movements of a complicated nature originally related to the structure, but finally having no obvious connection with it. Stress-strain curves of the crystals are given, and the fracture of β-brass crystals in tension and in rolling is described. N. M. B.

391. Structure of Ice. W. H. Barnes. *Roy. Soc. Canada, Trans.* 29. *Sect. III. pp.* 53–60, *May*, 1935.—The arguments in support of Bernal and Fowler's ice structure [see Abstract 3951 (1933)], in particular that the H atoms do not lie equidistant between pairs of tetrahedrally arranged O atoms, and that therefore there are discrete H_2O molecules in the structure, are insufficient, and do not exclude all other possible structures. Other views are also discussed, and further investigation urged before definite acceptance of any structure. C. A. S.

392. Structure and Entropy of Ice and of Other Crystals with Randomness of Atomic Arrangement. L. Pauling. *Am. Chem. Soc., J.* 57. *pp.* 2680–2684, *Dec.*, 1935.—It is suggested that ice consists of water molecules arranged so that each is surrounded by four others, each molecule being oriented in such a way as to direct its two H atoms toward two of the four neighbours, forming hydrogen bonds. The orientations are further restricted by the requirement that only one H atom lies near each O–O axis. There are $(^3/_2)^N$ such configurations for N molecules, leading to a residual entropy of $R \ln {}^3/_2 = 0{\cdot}805$ e. u., in good agreement with the experimental value 0·87 e. u. The structure and entropy of other crystals showing randomness of atom arrangement are discussed. Author.

393. Structure of Ice II. R. L. McFarlan. *J. Chem. Phys.* 4. *pp.* 60–63, *Jan.*, 1936.—The stability of the high pressure ice forms discovered by Tammann and Bridgman at very low temperatures and atmospheric pressure has made it possible to obtain X-ray powder diffraction photographs of these forms. The experimental procedure is very briefly discussed. An analysis of the ice II diffraction patterns leads to a side-centred orthorhombic cell with $a = 7{\cdot}80$, $b = 4{\cdot}50$, and $c = 5{\cdot}56$Å. This cell contains eight molecules, has the symmetry of space group $V^5 - C222_1$, and gives a value for the density of 1·21. The proposed arrangement of the H atoms indicates that the transition from ice I to ice II breaks up the water molecule, and that ice II is an ionic crystal. According to the model described the effect of a pressure of 2100 atmospheres in forming ice II is: (1) To decrease the packing volume of the oxygen ion approximately 3 per cent.; (2) to break down the open ice I structure by a slipping of the oxygen ion layers relative to each other;

(3) to give a four-coordinated structure where each oxygen is surrounded by a badly distorted tetrahedron of oxygen ions. AUTHOR.

394. Structure of Solid Oxygen. L. Vegard. *Zeits. f. Physik.* 98. 1–2. *pp.* 1–16, *Nov.* 30, 1935.—From powder photographs of β- and γ-O_2 it is found that β-O_2 is rhombohedral (not orthorhombic as suggested by McLennan and Wilhelm) and that γ-O_2 is cubic. The lattice constants of β-O_2 are $a = 6{\cdot}19$ Å. and $\alpha = 99{\cdot}1°$. The unit cell contains 6 molecules. The lattice constant of γ-O_2 is $6{\cdot}83$ Å. and the space group is T^6_h. The unit cell contains 8 molecules. These are arranged in pairs and each pair rotates about a point midway between the two molecules of the pair. These mid-points lie on a face-centred cubic lattice. The individual atoms have thus no fixed positions. The axes of rotation are also not fixed and take up all positions in turn. J. T.

395. Structure of Cupric Ammonium Bromide. A. Silberstein. *Comptes Rendus*, 201. *pp.* 970–971, *Nov.* 18, 1935.—By means of Laue and rotation photographs it is shown that the structure of $CuBr_2{\cdot}2Br(NH_4){\cdot}2H_2O$ is tetragonal like that of $CuCl_2{\cdot}2Cl(NH_4){\cdot}2H_2O$ with which it is it is isomorphous. The lattice dimensions are $a = 7{\cdot}98$ and $c = 8{\cdot}41$ Å. The space group is D^{14}_{4h} (P^4/mnm), and there are two molecules in the unit cell. The dimensions of the chloride are $a = 7{\cdot}63$ and $c = 7{\cdot}97$ Å. These agree with those found by Hendricks and Dickinson [see Abstract 32 (1928)]. J. T.

396. Structure of Cupric Chloride Dihydrate, $CuCl_2{\cdot}2H_2O$. D. Harker. *Zeits. f. Krist.* 93. *pp.* 136–145, 1936. *In English.*—The crystal structure of $CuCl_2{\cdot}2H_2O$ is determined and found to contain Cu atoms attached by covalent bonds to two Cl and two O atoms with the bonds directed toward the corners of a square. The bonding Cu–Cl distance, the non-bonding Cu–Cl distance and the Cu–O distance are found to correspond to the short Cu–Cl, the long Cu–Cl and the Cu–O distances in $K_2CuCl_4{\cdot}2H_2O$, respectively. $K_2CuCl_4{\cdot}2H_2O$ consequently also contains Cu forming four covalent bonds directed toward the corners of a square. The square covalent radius of Cu is set at $1{\cdot}32$ Å. AUTHOR.

397. Structure of the High-Temperature Silver Iodide. L. W. Strock. *Zeits. f. phys. Chem.* 31. *Abt.B.* 1–2. *pp.* 132–136, 1935.—The distinction between the author's structure for α–AgI, in which Ag^+ ions are scattered at random, "as a fluid," throughout a definite I^- structure, subject only to the total numbers of the two ions being equal [see Abstract 2284 (1934)], and Ketelaar's structure of α–Ag_2HgI_4, in which the indeterminable vacant spaces are due to Hg^{++} being divalent and so replacing $2Ag^+$, is emphasised. The structure proposed for α–AgI is slightly revised; it should be: a space-centred I^- lattice, in the 42 (not 30 as before) symmetrical spaces of which Ag^+ ions at the rate of $2Ag^+$ per unit cell are inserted according to their spacial requirements, and without reference to the geometrical properties of these spaces. C. A. S.

398. Structure of Cubic High-Temperature Modifications of Sulphides, Selenides and Tellurides of Ag and Cu. P. Rahlfs. *Zeits. f. phys. Chem.* 31 *Abt.B.*3. *pp.* 157–194, 1936.—The structures of α-Ag_2S, α-Ag_2Se, α-Ag_2Te, α-$Cu_{1{\cdot}8}S$, α-Cu_2Se and α-Cu_2Te are investigated. Both α-Ag_2S and α-Ag_2Se are body-centred cubic with 2 molecules per unit cell. The lattice constants are $4{\cdot}88$ and $4{\cdot}983$Å. respectively. The other cubic compounds are α-Ag_2Te, α-$Cu_{1{\cdot}8}S$ and α-Cu_2Se (α-Cu_2Te is not cubic), and they are face-centred, with 4 molecules per unit cell.

Their lattice constants are 6·572, 5·564, and 5·840Å. respectively. The structures are fully discussed. J. T.

399. Structure of AlB_2. W. Hofmann and W. Jäniche. *Zeits. f. phys. Chem.* **31.** *Abt.B.* **3.** pp. 214-222, 1936.—The structure of AlB_2 is investigated by means of rotation photographs. It is found to be hexagonal with $a = 3{\cdot}00 \pm 0{\cdot}01$Å and $c = 3{\cdot}24_5 \pm 0{\cdot}01$Å. The unit cell contains 1 molecule. The Al-atoms lie on a simple hexagonal lattice and the B-atoms occupy positions analogous to those occupied by C-atoms in graphite. J. T.

400. Structure of Al_5C_3N. M. v. Stackelberg and K. F. Spiess. *Zeits. f. phys. Chem.* 175. *Abt.*A. 1–2. *pp.* 140–151, 1935.—The structure of Al_5C_3N is investigated by means of X-ray powder, rotation, Laue and Weissenberg photographs. It is found to be hexagonal with $a = 3{\cdot}280$ and $c = 21{\cdot}55$Å. The space group is C_{6v}^4 and there are two molecules in the unit cell. The atomic positions, which involve 9 parameters, are given. The structure is of the layer-lattice type and consists of 5 Al-planes with 3 intermediate planes of C atoms and 1 of N atoms. It consists of an Al_4C_3 part and an AlN part. The lattice constants of Al_5C_3N bear a simple relationship to those of Al_4C_3 and AlN. A new determination is made of the lattice constants of AlN. It is found that $a = 3{\cdot}104$ and $c = 4{\cdot}965$ Å. J. T.

401. Structure of Cerium Tungstate. J. Beintema. *K. Akad. Amsterdam, Proc.* 38. 9. *pp.* 1011–1015, 1935. The substance is tetragonal-bipyramidal and possesses a scheelite-like structure, with $a_0 = 5{\cdot}33_6$ Å, and $c_0 = 11{\cdot}62_0$ Å, $(a : c = 1 : 2{\cdot}178)$ and a mass: $Ce^8/_3\ (WO_4)_4$ within its elementary cell. Only $\frac{2}{3}$ of the positions of the lead-atoms in $PbWO_4$, which forms an uninterrupted mixing-series with it, are occupied by Ce-atoms in $Ce_2(WO_4)_3$, the remaining places being void of atoms. Notwithstanding these empty places, the crystal structure of the mixed crystals of both salts, and of the crystals of cerium tungstate itself, proves to remain sufficiently stable. AUTHOR.

402. Structure and Composition of Sodium-dihydro-pyrostibiate. J. Beintema. *K. Akad. Amsterdam, Proc.* 38. 9. *pp.* 1016–1020, 1935. The salt crystallises in the tetragonal-bipyramidal class. The elementary cell has: $a_0 = 8{\cdot}00_5$Å; $c_0 = 7{\cdot}86_8$Å and contains a mass: $\{Na_2H_2Sb_2O_7 \cdot 5H_2O\}_2$. The atomic positions are: for 4 Sb: 4 (*c*): $\frac{1}{4}\ \frac{1}{4}\ 0$; $\frac{3}{4}\ \frac{1}{4}\ \frac{1}{2}$; $\frac{3}{4}\ \frac{3}{4}\ 0$; $\frac{1}{4}\ \frac{3}{4}\ \frac{1}{2}$; for 4 Na: 4 (*d*): $\frac{1}{4}\ \frac{1}{4}\ \frac{1}{2}$; $\frac{3}{4}\ \frac{1}{4}\ 0$; $\frac{3}{4}\ \frac{3}{4}\ \frac{1}{2}$; $\frac{1}{4}\ \frac{3}{4}\ 0$; for 24 O: 8 (*g*): $x\ y\ z$; $\bar{y}\ x\ z + \frac{1}{2}$; $\bar{x}\ \bar{y}\ z$; $y\ \bar{x}\ z + \frac{1}{2}$; $\frac{1}{2} - x\ \frac{1}{2} - y\ \bar{z}$; $y + \frac{1}{2}\ \frac{1}{2} - x\ \frac{1}{2} - z$; $x + \frac{1}{2}\ y + \frac{1}{2}\ \bar{z}$; $\frac{1}{2} - y\ x + \frac{1}{2}\ \frac{1}{2} - z$; with $x_1 = 0{,}35$, $y_1 = 0{,}15$, $z_1 = 0{,}20$; $x_2 = 0{,}35$, $y_2 = 0{,}45$, $z_2 = 0{,}05$; $x_3 = 0{,}05$, $y_3 = 0{,}30$, $z_3 = 0{,}15$. The kations and anions form a NaCl-like grating; in each anion an Sb-atom is surrounded by 6 O-atoms in an almost octahedral configuration. The structure is in accordance with Pauling's view of the substance having the composition: $NaSb(OH)_6$. AUTHOR.

403. Structure of Strontium and Barium Peroxides, SrO_2 and BaO_2. J. D. Bernal, E. Djatlowa, I. Kasarnowsky, S. Reichstein, A. G. Ward. *Zeits. f. Krist.* 92. 5–6. *pp.* 344–354, *Dec.*, 1935. *In English.* SrO_2 and BaO_2 are shown to have the CaC_2 structure and the sizes of the unit cells are given by: $a = 5{\cdot}02$, $c = 6{\cdot}55$ Å. and $a = 5{\cdot}34$, $c = 6{\cdot}77$ Å respectively. The structures are confirmed by density measurements and by the comparison between the calculated and observed intensities, the results in both cases being very satisfactory. The distance between the centres of the O-atoms in the O^{2-} ion are shown to be 1·35 Å in SrO_2 and 1·29 Å in BaO_2.

These distances are the length of the O–O single bond, the difference in the two cases being ascribed to contrapolarisation. Subject to allowances for this the length of the bond is taken to be : $1{\cdot}31 \pm 0{\cdot}03$ Å. AUTHORS.

404. Structure of α-Quartz. P'ei-Hsiu Wei. *Zeits. f. Krist.* 92. 5–6. *pp.* 355–362, *Dec.*, 1935. *In English.*—α-Quartz of the space group D_3^4 or D_3^6 is found to have the following four parameter values : $u = 167{\cdot}5° \pm 1{\cdot}5°$, $x = 150° \pm 5°$, $y = 100° \pm 5°$ and $z = 40° \pm 5°$. Interatomic distances and angles between Si — O are computed from this structure and found to be very reasonable. An extinction curve of great curvature is obtained showing that primary extinction is important in the quartz crystal used. Absolute intensities of type $(hk0)$, $(h0l)$, $(h00)$, $(00l)$ are measured and found proportional to, but about five times greater than, those computed from perfect crystal formula. AUTHOR.

405. Structure of H_2O_2. F. Fehér and F. Klötzer. *Zeits. f. Elektrochem.* 41. *pp.* 850–851, *Dec.*, 1935.—The structure of H_2O_2 is investigated by means of powder photographs taken in a special camera. It is found to be tetragonal with $a = 4{\cdot}02$ and $c = 8{\cdot}02$ Å. There are 4 molecules in the unit cell. J. T.

406. Structure of Hexaethylbenzene. H. K. Pal and A. C. Guha. *Zeits. f. Krist.* 92. 5–6. *pp.* 392–394, *Dec.*, 1935. *In English.*—The crystals, grown out of solutions in acetone or benzene, belong to the triclinic system, and goniometric measurements give axial ratios and angles, $a : b : c = 1{\cdot}004 : 1 : 0{\cdot}610$; α 58°5′, β 103°54′, γ 123°43′. The calculated and measured angles between different faces are tabulated. X-ray rotation photographs give for the dimensions of the unit cell a 9·90, b 9·84, c 6·10 Å, corresponding to the ratio $1{\cdot}006 : 1 : 0{\cdot}620$. The volume of the unit cell is 418×10^{-24} c.c., and the density of the crystal 0·94, giving the mass of the unit cell 393×10^{-24} gms., as compared with the molecular weight 406×10^{-24} gms. There is thus only one molecule in the unit cell. Comparison with the corresponding data due to Lonsdale [see Abstract 2676 (1929)] for hexamethylbenzene shows a strong resemblance between the two crystals. N. M. B.

407. Magnetic Anisotropy and Structure of Hexaethylbenzene, $C_6(C_2H_5)_6$. N. Ganguli. *Zeits. f. Krist.* 93. *pp.* 42–46, 1936. *In English.*—An account is given of some magnetic measurements on single crystals of hexaethylbenzene. The crystals are triclinic with one molecule in the unit cell. It is found that two of the principal susceptibilities are nearly equal, and numerically much smaller than the third. The plane of approximate magnetic symmetry is almost in the (010) zone, inclined at about 15½° to (001) and at 79° to (100). The benzene rings of the molecules should be nearly parallel to the above plane. The principal susceptibility along the normal to this plane $= -231 \times 10^{-6}$ per gm. mol. and that for directions in the plane $= -165 \times 10^{-6}$. AUTHOR.

408. Structure of Condensed Ring Compounds. Part II. 7-Methoxy-3′ : 3′-dimethyl-1 : 2-cyclopentenophenanthrene and 7-Methoxy-1 : 2-cyclopentenophenanthrene. J. Iball. *Zeits. f. Krist.* 93. *pp.* 47–56, 1936. *In English.*—An account is given of an X-ray study of the crystal structure of two derivatives of 1 : 2-cyclopentenophenanthrene. The crystals of both compounds were found to be monoclinic prismatic with the following unit cell dimensions, etc., (1) 7-Methoxy-3′: 3′-dimethyl-1 : 2-cyclopentenophenanthrene, $a = 8{\cdot}75$ Å, $b = 6{\cdot}21$ Å, $c = 28{\cdot}02$ Å, $\beta = 95{\cdot}0°$; 4 molecules per unit cell ; observed density = 1·188 (20°C.) ; space group $C_{2h}^5 - P2_1/c$. Optical data :

Sign (−); optic axial plane (010); β along b; γ about 18° from perpendicular to (001). (2) 7-Methoxy-1 : 2-cyclopentenophenanthrene, $a = 29{\cdot}9$ Å, $b = 5{\cdot}68$ Å, $c = 8{\cdot}49$ Å, $\beta = 117{\cdot}5$ Å; 4 molecules per unit cell; observed density = 1·274 (20° C); space group $C_{2h}^5 - P2_1/a$. Optical data: Sign (−); optic axial plane (010); β along b; γ about 34° from a axis in the acute angle between a and c. Suggestions are put forward as to the arrangement of the molecules in the case of each compound on the basis of the unit cell-dimensions, the optical data and the intensity of reflection from various planes. [For Part I see Abstract 59 (1936).]

AUTHOR.

409. Structure of Nitrogen-Substituted Sulphon-*o*-toluidides. G. H. Young, W. J. Keith and A. P. Honess. *Zeits. f. Krist.* 92. 5–6. *pp.* 395–401, *Dec.*, 1935. *In English.*—The following *p*-toluene-sulphon-N-alkyl-*o*-toluidides have been measured crystallographically :—

Alkyl.	Crystal System.	$a : b : c$	β
methyl ..	orthorhombic-bipyramidal	0·6188 : 1 : 0·1968	—
ethyl ..	monoclinic-prismatic ..	0·7023 : 1 : 0·4109	88° 1′
n-propyl ..	do. do. ..	1·1571 : 1 : 1·1606	83° 58′
isopropyl ..	do. do. ..	0·6811 : 1 : 0·4381	85° 51′
n-butyl ..	do. do. ..	1·8303 : 1 : 1·771	81° 39′
isobutyl ..	orthorhombic-bipyramidal	0·5441 : 1 : 0·8371	—
isoamyl ..	monoclinic-prismatic ..	1·8953 : 1 : 1·1756	84° 22′

Gnomonic and orthographic projections of all are given. [See also Abstract 58 (1936).] C. A. S.

410. X-Ray Measurements on Diamond. M. Renniger. *Zeits. f. techn. Physik*, 16. 11. *pp.* 440–443, 1935. *Phys. Zeits*, 36. *pp.* 834-837, *Dec.* 1, 1935.—Intensity measurements are made of the " forbidden " (222) reflection in diamond. Several diamonds are examined and limits are obtained for the structure-factor of the plane in question. J. T.

411. X-Ray Diagrams of Sugar Charcoal after Various Thermal Treatment. P. Corriez. *Comptes Rendus*, 201. *pp.* 1189–1191, *Dec.* 9, 1935.—The X-ray diagrams of five samples of sugar charcoal prepared at 1000° and subsequently heated for two hours at 1200°, 1400°, 1600°, 1800° and 2000° respectively are compared. These show a progressively increasing similarity to the diagram of natural graphite, though that of the highest heated sample still showed a distinct difference. [See Abstract 4015 (1934) and 821 (1936).] C. A. S.

412. Orientation of Molecules of Beeswax. P. Woog and N. Yannaquis. *Comptes Rendus*, 201. *pp.* 1400–1402, *Dec.* 23, 1935.—Examination of beeswax by X-rays shows that its molecules when first built into the cell wall possess very little definite orientation, but that this increases with time at a rate which increases rapidly with temperature. Thus wax showing practically no orientation showed it distinctly after 23 days at 30°, and more so after 3 days at 40°. Beeswax from a hot country is much more oriented than that from a cold one. C. A. S.

413. Crystal Faults and Growth Control. E. Herlinger. *Zeits. f. Krist.* 92. 5–6. *pp.* 372–379, *Dec.*, 1935.—A fault in a lattice produces during crystal growth further faults around it. The distribution and variation of frequency of these secondary faults during growth is studied. It appears that the course of growth and the habit can be altered by these

faults. A real crystal has a maximum number of faults. [See following Abstract.] J. E.

414. Structure of Real Macrocrystals. E. Herlinger. *Zeits. f. Krist.* 92. 5–6, *pp.* 380–386, *Dec.*, 1935.—Continuing the previous paper [see preceding Abstract] it is pointed out that the cause of the growth control by faults lies in the decrease of free energy of a surface point of an irregularly growing crystal as compared with that of an ideal crystal. Some further consequences of this idea are discussed. J. E.

415. Etch Planes of Tin. L. W. McKeehan and H. J. Hoge. *Zeits. f. Krist.* 92. 5–6. *pp.* 476–478, *Dec.*, 1935. *In English.*—The crystallographic axes of single crystals of tetragonal tin are determined by an etching method. A specially designed crystal holder is used and the acid employed for etching is HCl. Details of the method are given. J. T.

416. Linear Crystallisation Velocity. T. Förster. *Zeits. f. phys. Chem.* 175. *Abt.A.*3. *pp.* 177–186, 1935.—The conditions governing the rate of crystallisation of a substance and the variations therein for different degrees of under-cooling are discussed with special reference to the disposal of the heat evolved on solidification. It is concluded that unless the rate of crystallisation is very low or the tube in which crystallisation occurs very narrow (the suitable diameter varying inversely with the rate) the temperatures at the centre and wall of the tube, as well as that of the surrounding atmosphere are all governing factors, and not merely that at the actually crystallising surface which is not constant [see Abstract 246 (1930)]. On these grounds an approximate mathematical formula is deduced. C. A. S.

417. Dynamic Theory of Crystal Optics. G. Molière. *Ann. d. Physik*, 24. 7. *pp.* 591–608, *Nov.*, 1935.—It is shown that the methods developed by v. Laue for X-ray crystal optics, when applied to long wavelengths, account also for double refraction and optical rotatory power. The results are in agreement with the Born-Ewald lattice theory. C. B. A.

***418. Crystal Properties and Magnetic Anisotropy of Distilled Bismuth. A. Goetz, O. Stierstadt and A. B. Focke.** *Zeits. f. Physik*, 98. 1–2. *pp.* 118–127, *Nov.* 30, 1935.—An apparatus is described in which Bi may be distilled *in vacuo* and condensed on a cooled surface. The condensate consists of a microcrystalline layer about 0·5 mm. thick on which a macrocrystalline conglomerate then forms; this consists of similarly orientated crystals with their [111] axis approximately parallel to the direction of growth and arranged in strata of approximately equal separations of $0 \cdot 5\mu$. The magnetic anisotropy of crystals of the condensate is measured by the method described by Guy and it is concluded that the distillation of Bi as a method of purification is of little value unless a very pure initial product is used. H. J. H. S.

419. Stabilised Cubic Ferric Oxide. A. Michel and G. Chaudron. *Comptes Rendus*, 201. *pp.* 1191–1193, *Dec.* 9, 1935.—Solid solutions of varying amounts of $NaFeO_2$ in Fe_2O_3 are prepared by adding varying amounts of NaOH to precipitated Fe_2O_3, reducing to Fe_3O_4 and finally heating to 650°. As the content of Na_2O increases the Curie point decreases and the side of the unit cube (a) increases, the figures for an oxide containing 5 % Na_2O being 400° and 8·54 Å and those for pure Fe_2O_3 (by extrapolation) 675° and 8·32 Å. The dissociability of Fe_2O_3 decreases rapidly with increase of Na_2O, practically disappearing with 5 % thereof at 300°. Though hydrolysis in hot H_2O or acetic acid removes more or less of the Na_2O, the Curie point and a are unchanged until

after reheating at 650°. Solid solutions of other ferrites behave similarly, the Curie points of the limit solutions of those of Be, Ag and K being at 220°, 270° and 250° respectively. C. A. S.

420. Torsion Modulus of Quasi-Isotropic Multiple Crystals from the Single Crystal Constants. W. Boas. *Helv. Phys. Acta*, 8. 8. *pp.* 674–681, 1935.—The torsion modulus of quasi-isotropic multiple crystals has been calculated from the behaviour of a single crystal by obtaining average value over the total region of orientation, on the hypothesis that the processes in the separate crystals play a part independently of each other. Reciprocal influence of the crystals in the multi-crystalline aggregate is now so taken into account that the hindering of the circumflection in free crystals coupled with torsion is considered. The torsion modulus so corrected agrees well with the results of observation. J. J. S.

421. Variation of the Adiabatic Elastic Moduli of Rock-Salt with Temperature between 80° K. and 270° K. F. C. Rose. *Phys. Rev.* 49. *pp.* 50–54, *Jan.* 1, 1936.—The piezoelectric method devised by Balamuth [see Abstract 2722 (1934)] for measuring Young's modulus of a cubic crystal for any chosen direction is extended to permit the measurement of all the elastic moduli of any solid crystal at temperatures below 0° C. Data are given which show the variation of the adiabatic and isothermal elastic moduli and elastic constants of rock-salt with temperature between 80° K. and 270° K. AUTHOR.

***422. Crystal Structure Models. M. J. Buerger.** *Rev. Sci. Instruments*, 6. *pp.* 412–416, *Dec.*, 1935.—An account is given, with figure of the complete instrument and working drawings, of apparatus for drilling oriented holes in spheres, as required for the construction of crystal structure models. C. A. S.

***423. X-Ray Microscope. G. Shearer.** *Brit. J. of Radiology*, 9. *pp.* 30–37, *Jan.*, 1936.—An account of the application of X-radiations to the study of crystalline structure. Special attention is paid to the use of the X-ray diffraction method for the investigation of fibre structures, *e.g.*, cold worked metals, cotton, wool, silk and materials of great interest to the biologist—the human tooth, hair and muscle tissues. C. J. B. C.

See also Abstracts **431, 433, 607, 608, 613, 614, 628, 640, 667, 738, 749, 777, 815, 820, 824, 838, 849, 853, 858, 876, 878.**

DENSITY.

424. Influence of Degree of Dispersion on Physical-Chemical Constants. E. Cohen and J. J. A. Blekkingh, Jr. *K. Akad. Amsterdam, Proc.* 38. 9. *pp.* 978–982, 1935. *In German.*—By measurements using the Andreae dilatometer the density at 25° C. of salicylic acid crystals of mean thickness 0·05 mm. was found to be 1·4339 ± 0·0017 gm./ml. and that found for crystals of mean thickness 0·7 mm. was 0·4342 ± 0·0005 gm./ml. [See Abstract 1307 (1933).] P. H. B.

See also Abstracts **768, 779.**

DIFFUSION AND OSMOSIS.

425. Diffusion of Helium through Fused Silica. E. O. Braaten and G. F. Clark. *Am. Chem. Soc., J.* 57. *pp.* 2714–2717, *Dec.*, 1935.—It is found for the diffusion of He through fused silica that (*a*) the gas passing through is proportional to the pressure, (*b*) increasing the emergent surface many times only slightly increases the rate of diffusion,

and (*c*) the rate of diffusion is inversely proportional to the thickness, which is in accord with Fick's law of diffusion. Two values for the activation energy are obtained depending on the temperature region for which the experiments are carried out. The magnitude for $W_0 + E_0$ is found to be independent of the thickness of the sample and to depend on the silicate content. AUTHORS.

426. Diffusion of Hydrogen through Copper. E. O. Braaten and G. F. Clark. *Roy. Soc., Proc.* 153A. *pp.* 504–512, *Feb.* 1, 1936.—The rate of diffusion of H_2 through copper is determined for several temperatures and pressures. The effect of temperature is represented by the usual exponential relation, and an activation energy of 19,700 cal./gm. atom is obtained. The effect of pressure can be nearly represented by the equation $M \propto p^{\frac{1}{2}} c_2 p/(1 + c_2 p)$. The small departure from the above equation which occurs at about 2 mm. pressure is thought to be partly due to the adsorption factor. AUTHORS.

See also Abstracts 387, 560.

ELASTICITY AND PLASTICITY.

427. Tensors Associated with a System of Geodesics and Their Application to the Problem of Clebsch. Maria Pastori. *Accad. Lincei, Atti*, 21. *pp.* 801–808, *June* 16, *and* 22. *pp.* 251–255, *Sept.*, 1935.—If a system of geodesics in space is given and the surfaces which are their orthogonal trajectories, a curvilinear coordinate system x_1, x_2, x_3 can be taken in which x_3 is the distance along the geodesics and x_1, x_2 are coordinates in each of the orthogonal surfaces. Tensors associated with this system are quantities which are tensors with respect to a change of coordinates in which x_3 is left unaltered, and the derivatives of such tensors are here discussed. These associated tensors are applied to the problem of Clebsch in the elastic equilibrium of cylinders for the two special cases where the surface bases of the cylinders are (1) plane, (2) spherical.

A. J. McC.

428. Torsion of a Circular Cylinder. R. F. Deimel. *Nat. Acad. Sci., Proc.* 21. *pp.* 637–642, *Dec.*, 1935.—Saint-Venant's solution of the torsion problem is based on the assumption that a transverse section of the cylinder suffers no distortion in its own plane. The problem of the circular cylinder is here solved without it in order to find what effects arise from the boundary conditions at the ends. It is shown that a non-linear symmetrical stress distribution at the ends does not change the linear relation of Saint-Venant, and it is reasonable to infer that any type of distribution will also be without appreciable influence. A. J. McC.

429. Stress Calculation for a Radially Braced Polygonal Ring. R. V. Southwell and J. B. B. Owen. *Phil. Mag.* 20. *pp.* 1073–1092, *Dec.*, 1935.—A method and notation already developed [see Abstract 2165 (1933)] are applied to the determination of the stresses induced in a radially braced polygonal ring by any (self-equilibrating) system of applied forces acting in its own plane. The N radial members are similar and are able to resist such compression as may be entailed by the solutions given; in addition, the central joint is frictionless. The conception of tension coefficients is again introduced, and the following features of the problem are investigated:—The effects of joint rigidity are deduced; by the introduction of a "quasi-harmonic assumption" a complete solution of the

problem of stress calculation for the stiff polygonal ring with a fixed central joint is obtained (the validity of the assumption is afterwards verified); the stiffness of the frame to purely radial and tangential forces is examined, and is illustrated with the results of measurements on a ring representative of a bulkhead of the airship "R 100"; the general solution for the pin-jointed ring and the procedure in the general case are summarised; finally, a complete and exact solution is obtained by synthesis. H. J. H. S.

430. Stresses in a Disc Wheel under Loads Applied to the Rim. L. Chitty and A. J. S. Pippard. *Phil. Mag.* 21. *pp.* 106–127, *Jan.*, 1936.—In continuation of previous work in which expressions were derived for the stresses in spoked wheels under loads applied to the rim [see Abstract 4748 (1932)] expressions are now derived for the stresses in a continuous disc wheel with or without a rim. J. S. G. T.

431. Quantum Mechanical Calculation of the Elastic Constants of Monovalent Metals. K. Fuchs. *Roy. Soc., Proc.* 153A. *pp.* 622–639, *Feb.* 1, 1936.—The method developed by Wigner and Seitz for calculating the lattice energy and compressibility of monovalent metals is extended to account for their other elastic properties. The elastic constants of Li, Na, K, and Cu are calculated. For Cu satisfactory agreement with the observed values is obtained. As the elastic constants of the alkalis have not been measured, the Debye characteristic temperatures of Li, Na, and K are calculated from the theoretical elastic constants and compared with the values observed at low temperatures. It is shown further that the elastic constants of metals do not obey the Cauchy relations. [See also Abstract 4121 (1935)]. AUTHOR.

432. Modulus of Elasticity of Materials for Small Stresses. R. H. Evans and R. H. Wood. *Phil. Mag.* 21. *pp.* 65–80, *Jan.*, 1936.—Values of Young's modulus of columns of steel, cast iron, glass, slate, marble, granite, sandstone and concrete, in compression, are found to increase rapidly in value as the range of applied stress is increased from zero. These results are explained by a theory which contemplates the columns as being composed of elastic elements of different stiffnesses, some being in compression and some in tension. Moreover, the initial rise in the value of the modulus is found to be followed by a gradual decrease as the range of applied stress is further increased. The theory advanced is capable of explaining the whole of the results, provided the modulus of the columns in compression, forming the composite test-piece, decreases gradually with increase of the range of stress. The theory is confirmed by results obtained with cast iron in tension, and the results of Froman's work are satisfactorily explained. J. S. G. T.

433. Plasticity of Crystals. E. Orowan. *Zeits. f. Physik*, 98. 5–6. *pp.* 382–387, *Dec.* 23, 1935.—This paper deals with the completion of the formula for the rate of slip [see Abstract 3509 (1934)], by making the addition of a symmetrical force term opposed to the prevailing thrust, whereby for diminishing thrust there is a diminishing rate of slip. The new term is practically of imperceptible effect for metallic crystals, but for other cases, and in particular those of organic crystals, the term may assume considerable importance. H. H. Ho.

434. Tensile Strength of Glass Rods. M. Eichler. *Zeits. f. Physik*, 98. 3–4. *pp.* 280–282, *Dec.* 14, 1935.—Tensile tests on glass rods show that, contrary to what was found at room-temperature, a decrease in

the velocity of loading at temperatures of about 400° C. and 445° C. produce an increase of tensile strength of the rods. J. S. G. T.

***435. Apparatus for Testing the Elastic Properties of Filaments. I. J. Saxl.** *Rev. Sci. Instruments*, 6. *pp.* 409–412, *Dec.*, 1935.—Load-extension diagrams are derived for filaments by means of a chainomatic balance application. An analogous construction may be used for mercury and shot loading. The paper records investigations of hysteresis loops at various points of stress application and removal. Such loops are characteristic for specific materials and afford a means of their identification. The changes which occur in physical structure on loading, etc., are also noted. Details are given of the chain weight principle apparatus and the parallax eliminator for the pointer. S. G. B.

See also Abstracts 386, 387, 456, 457, 642.

GRAVITATION.

436. Relative Geoid Lifting by the Tibet and Himalaya Masses. K. Mader. *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 130–141, 1935.—The partial lifting of the geoid caused by the masses of the Tibetan plateau and Himalayan Mountains is calculated with and without assumptions of isostasy. The same method is employed as was used for Alpine masses. [See Abstract 580 (1935).] R. S. R.

437. Crustal Warping in the United States. E. A. Glennie. *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 193–197, 1935. *In English.*—Isostatic anomalies in the United States and Southern Canada are examined and a marked relation between them and latitude and elevation is found. The correlation with height appears to be quantitatively similar to that found in India. It is concluded therefore that the warp anomalies which have proved useful in India, will also effectively portray the tectonic structure in the United States, and the method by which they may be derived is given. [See Abstract 1835 (1934).] AUTHOR.

438. Attraction of Homogeneous Rectangular and Cylindrical Bodies. E. A. Ansel. *Beitr. z. angew. Geophys.* 5. 3. *pp.* 263–295, 1935.—To enable the effect of disturbing bodies, causing gravity anomalies to be determined, the attraction of bodies in the forms of a parallelepiped and of a cylinder are worked out. Taking the origin of the coordinates at the attracting point outside the bodies, equations are given that should enable the anomalies due to the disturbance of a troughlike body of low density, or a salt-dome, to be calculated and compared with the observed anomalies. W. A. R.

***439. Stroboscopic Study of Falling Liquid Drops. E. Tyler.** *School Science Rev. pp.* 40–50, *Oct., and pp.* 229–239, *Dec.*, 1935.—Stroboscopic methods are described in which a liquid jet projected either horizontally or upwards is resolved into drops at a definite rate by coupling it to a vibrator consisting of either (*a*) an electrically-maintained reed driven from the a.c. mains, or (*b*) a valve oscillator controlled loud-speaker unit. The drops are illuminated by intermittent light of the same frequency as their resolution, by either an auto lamp synchronous motor or vibrating reed device, or by a flashing " Osglim " coupled to the valve oscillator. Under such conditions the apparently stationary drops register their own displacement-time curves, and the measurement of such trajectories, by employing a visual graphical method or travelling microscope, permits the computation of " g." Stroboscopic and spark

photographs are also included from which " g " is also determined. A stroboscopic dual reed shadowgraph method is described in an Appendix. [See also Abstract 3958 (1935).] AUTHOR.

HYDRODYNAMICS AND AERODYNAMICS.

440. Appearance of a Shock-Wave in an Aerodynamic Field at Subsonic Velocities. L. Gabeaud. *Comptes Rendus*, 201. *pp.* 1460–1461, *Dec.* 30, 1935.—Several investigators have shown the appearance of a shock-wave in an aerodynamic field produced by a fluid flowing round a solid with velocity at infinitely less than the velocity of sound. A demonstration of this fact is given for the particular case of a cylindrical ogive projectile and the fact is connected with the theory of turbulence in the air developed in a previous article. [See Abstract 3312 (1931).] G. F. P. T.

441. Dubuat's Paradox. N. W. Akimoff. *Accad. Lincei, Atti*, 22. *pp.* 60–63, *July*, 1935.—If R is the resistance experienced by an obstacle forced to move with given velocity through still water, and R_1 is the resistance experienced by the same obstacle held fixed in a stream flowing with the same velocity, then R_1/R is approximately equal to $1 \cdot 3$. This is Dubuat's paradox and is usually explained as being due to the presence of turbulence in the liquid. Two experiments are here described which could be performed to decide whether the difference in the resistances is due to turbulence or not. A. J. McC.

442. Dynamical Actions on a Circular Obstacle with a Source Immersed in a Current. U. Cisotti. *Accad. Lincei, Atti*, 22. *pp.* 275–279, *Oct.*, 1935.—The pressures exerted on a circular obstacle (1) with a source on its boundary in a stream of liquid, and (2) with a source alone are in each case indeterminate ; but the difference of the pressures in these two cases can be calculated. This difference is found to consist of the ordinary Kutta-Joukowski action together with other forces. These last forces are here analysed and are referred to as the " ballast effect." [See following Abstract.] A. J. McC.

443. " Ballast Effect " Relative to a Rectilinear Lamina. U. Cisotti. *Accad. Lincei, Atti*, 22. *pp.* 279–283, *Oct.*, 1936.—This paper carries out the same calculation [see preceding Abstract] on the pressures exerted on a rectilinear lamina with a source in the presence of a stream of liquid. A. J. McC.

444. Transmissibility of Long Waves along a Canal with Abrupt Changes in Depth. K. Kurihara. *Imp. Acad. Tokyo, Proc.* 11. *pp.* 316–318, *Oct.*, 1935. *In English.*—The problem of a water wave which is partly reflected and partly transmitted at a point where there is an abrupt change in the section of the canal is extended to the case when there are two such points, so that the portion of the canal between them is shallower or deeper than other portions, in order to determine the effect of such conditions upon the transmissibility of long waves. The effect of the shallower or deeper portion is to render the canal selective for a complex wave. It is hoped that the investigations may be of use in the study of tunami proceeding along a canal-like estuary of variable depth, or for lessening their destructive power. G. F. P. T.

445. Internal Forces in Turbulent Media and General Equations of Turbulence. G. Mattioli. *Accad. Lincei, Atti*, 22. *pp.* 49–54, *July*, 1935.—A turbulent medium is specified by two vectors : the density

of momentum ρv per unit volume and the density of angular momentum $\rho\lambda^2\omega$ per unit volume, where $\omega = \text{curl } v$. The transport of momentum across a surface in the medium gives rise to a symmetric stress tensor, whose components for an isotropic medium can be written in the form :

$\tau_{xx} = \rho\epsilon\{2\,\partial u/\partial x - 2/3 \text{ div } v\}$, $\tau_{xy} = \tau_{yx} = \rho\epsilon(\partial w/\partial y + \partial v/\partial z)$, etc. The transport of angular momentum across a surface gives rise to a skew-symmetric stress tensor, which can be replaced by a stress vector M per unit area. These two stress tensors together with the ordinary pressure constitute the total internal forces of the medium. The general equations of turbulence are :

$\rho du/dt = \rho X + \partial\tau_{xx}/\partial x + \partial\tau_{yx}/\partial y + \partial\tau_{zx}/\partial z + \frac{1}{2}(\partial M_z/\partial y - \partial M_y/\partial z) - \partial p/\partial x$, with two similar equations, and

$\rho d\xi/dt = \partial(\rho\epsilon\partial\xi/\partial x)/\partial x + \partial(\rho\epsilon\partial\xi/\partial y)/\partial y + \partial(\rho\epsilon\partial\xi/\partial z)/\partial z - M_x/\lambda^2$, with two similar equations, where ξ is the first component of ω and X is the first component of the body force. To these equations must be added the equation of continuity and the equation of state. A. J. McC.

446. Turbulent Flow in a Circular Pipe. A. Fage. *Phil. Mag.* 21. *pp.* 80–105, *Jan.*, 1936.—In continuation of previous work [see Abstract 3085 (1932)] the ultramicroscope has been employed to investigate the conditions of turbulent flow in a *circular* pipe. Measurements of the mean velocity (U) taken with the ultramicroscope were found to be in very close agreement, except near the wall, with Pitot measurements made by Stanton ; they linked up satisfactorily with those taken very near the wall, by Stanton with small surface tubes. Observations on an axial plane showed that the maximum deviation of particles moving away from the wall is greater than that of those moving towards the wall. u_1, v_1 and w_1 denoting respectively maximum values of (1) longitudinal velocity, fluctuation, (2) radial component of disturbed velocity, and (3) tangential component of disturbed velocity, it was found that distributions of the turbulent components, u_1/U, v_1/U and w_1/U in a circular pipe bear a general resemblance to those already found in a square pipe ; but values of the ratios u_1/v_1 and u_1/w_1 on the axis are greater. The ratios u_1/U_f, and w_1/U_f where U_f denotes the frictional velocity, have their maximum values at a distance, y_1, from the wall given by $y_1 = 22\cdot4\nu/U_f$, where ν is the kinematic coefficient of viscosity. At this distance, the curve of mean velocity, plotted in the form U/U_f against $\log(U_f\,y_1/\nu)$ experiences a notable change of shape. J. S. G. T.

447. Axial Movements in an Incompressible Viscous Liquid. A. Rosenblatt. *Comptes Rendus*, 201. *pp.* 1012–1014, *Nov.* 25, 1935.—New solutions in series are given of the equations

$$\nu\left[\frac{\delta^2 w}{\delta r^2} + \frac{\delta}{\delta r}\left(\frac{w}{r}\right) + \frac{\delta^2 w}{\delta z^2}\right] + \frac{\delta\psi}{\delta z^2}\frac{\delta}{\delta r}\left(\frac{w}{r}\right) - \frac{1}{r}\frac{\delta\psi}{\delta r}\frac{\delta w}{\delta z} = 0$$

where $w = \dfrac{\delta}{\delta r}\left[\dfrac{\delta\psi}{\delta r}/r\right] + \dfrac{1}{r}\dfrac{\delta^2\psi}{\delta r^2}$, for the stationary motion of an incompressible viscous liquid about the z-axis. G. F. P. T.

448. Breaking-up of a Drop of Viscous Liquid Immersed in another Viscous Fluid which is Extending at a Uniform Rate. S. Tomotika. *Roy. Soc., Proc.* 153*A*. *pp.* 302–318, *Jan.* 1, 1936.—The mode of breaking up of a drop is discussed for the case in which the fluid of immersion is extending at a uniform rate in one direction and contracting symmetrically in all directions at right angles to this. Taylor's experiments [see Abstract 4397 (1934)] indicate that the instability of the drop for

a certain distortion of the outer fluid is inhibited by the field of flow. It is shown, for a drop of black lubricating oil in syrup, that any initial disturbance initiated as soon as the thread is just formed from the original drop cannot increase to more than 20·89 times the initial disturbance, so that true instability does not occur when the drop is surrounded by the field of flow which causes the drop to burst into thread-like form. It is also shown that although the maximum possible magnification of initial disturbances is very small, disturbances formed at a later stage in the process of drawing out can increase in a very great ratio ; *e.g.*, a disturbance first formed when the thread has been reduced in the ratio 10 : 1 can increase in relative amplitude $1 : 8{\cdot}78 \times 10^{12}$. These theoretical results explain the observed fact that in the stretching field of flow the thread remains cylindrical until it has extended sufficiently to form small drops of about 1/1000 of the volume of the initial drop. [See also Abstract 2839 (1935).] N. M. B.

449. Non-Isentropic Tubes of Flow. J. Villey. *Comptes Rendus*, 201. *pp.* 1471–1473, *Dec.* 30, 1935.—Continuous flow for the permanent gases is considered without any discontinuities. The speed of flow V and the physical state of the gas are simple functions of the distance x, and their variations are discussed. From the basic equations of continuity, conservation of energy, and of the perfect gas, expressions are obtained for the variations of V, ρ, T and p along the tube. In a table are given the respective signs for the three factors, α, q and w according to the value of k and all special cases are covered. R. S. R.

450. Settling of a Suspension Flowing along a Tube. W. B. Morton. *Roy. Irish Acad., Proc.* 43*A*. 1. *pp.* 1–4, 1935.—A fluid, flowing steadily along a tube of circular section, is transporting a large number of uniform particles of different density which fall through the fluid at a steady velocity. At an initial cross-section the particles are uniformly distributed. It is desired to find the manner in which the deposited particles are distributed along the length of the tube, measured from this section. Two limiting cases are considered; the first when the flow is of the regular Poiseuille type, the second when the fluid is kept stirred up by eddies, so that both the density of the particles and their rate of transport along the tube may be regarded as uniform over every cross-section. The law of settling may lie between the results given on the two suppositions.

G. F. P. T.

See also Abstracts 484, 553.

KINETIC THEORY OF MATTER.

451. Scattering of Molecular Rays in Gases. R. G. J. Fraser, H. S. W. Massey and C. B. O. Mohr. *Zeits. f. Physik*, 97. 11–12. *pp.* 740–744, *Nov.* 25, 1935.–The determination of the collision cross-section by the scattering of a narrow beam of molecular rays which is passed at right angles through another beam, depends on the formula used to extrapolate to the intensity of the unscattered component of the primary beam. For the case of a primary beam of rectangular section two approximate formulæ due to Broadway and Knauer respectively are examined, and by comparison with a rigorous formula the Knauer expression is found to give a better approximation. Applying the Knauer formula to Broadway's experimental results for Na-Hg and K-Hg new values for the collision cross-section for these two cases are obtained which are in conformity with the van der Waals potentials to be expected. W. S. S.

452. Brownian Motion of an Ellipsoid. Part II. Free Rotation and Depolarisation of Fluorescence: Translation and Diffusion of Ellipsoidal Molecules. F. Perrin. *J. de Physique et le Radium*, 7. *pp.* 1–11, *Jan.*, 1936.—An analytical study is given of the Brownian motion of rotation of an ellipsoid starting from an equation previously established [see Abstract 96 (1935)]. Application is made to the calculation of the depolarisation, resultant of the rotations of excited molecules for a fluorescence emitted by ellipsoidal molecules in solution. A study is given of the equation with partial derivatives of the complete Brownian motion, both rotation and translation, of an ellipsoid; and also of the diffusion of dissolved ellipsoidal molecules. Local anisotropy resulting from diffusion is considered, and the existence for small degrees of concentration in the limit, of a coefficient of diffusion. Formulæ and curves are given showing the values of this coefficient of diffusion for ellipsoids of revolution. J. J. S.

See also Abstracts 773, 774.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***453. Length Variations of Invar Wires. P. Werkmeister.** *Zeits. f. Instrumentenk.* 55. *pp.* 499–501, *Dec.*, 1935.—Describes a method of determining variations in the length of 24 m. invar wires. Three wires are individually compared with 24 m. bases set up on a suitable wall of a 3-storey building, one base being arranged on each floor. The average accuracy of comparison is between $\pm 0{\cdot}02$ and $\pm 0{\cdot}03$ mm., and it is established that in the case of the 3 wires used no changes greater than $0{\cdot}1$ mm. take place within 5 years. This is confirmed by standardisations of the wires at the Physikalisch-Technische Reichsanstalt. H. B.

See also Abstracts 485, 486.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

***454. Electrical Recording of Oscillations of the Beam of a Microbalance. P. S. Rini.** *Comptes Rendus*, 201. *pp.* 1468–1470, *Dec.* 30, 1935.—The principle of a method of studying small vibrations [see Abstract 2691 (1932)] is applied to the photographic recording of minute movements of the beam of a microbalance. A metallic disc is rigidly attached to one end of the beam of the balance, and beneath it are supported a pair of semi-circular plates insulated from each other, the whole forming a double condenser. With this condenser are associated two oscillating circuits tuned to resonance, and across the condenser is connected a quartz resonator of the type described by Giebe and Scheibe, which becomes luminous when its electrical frequency coincides with the mechanical frequency of the quartz cell. The illumination of the quartz resonator is recorded on a photographic film, the intensity of blackening of this film after development being a function of the capacity of the double condenser. Different methods of photographic recording suitable for observing (*a*) micro-oscillations of the balance beam and (*b*) the rest point of a microbalance, are described. J. S. C.

***455. Modern Developments in Chemical Balances. J. L. Buchan.** *Journ. Sci. Instruments.* 13. *pp.* 1–4. *Jan.*, 1936.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

456. Inspectional Analysis: a Method which Supplements Dimensional Analysis. A. E. Ruark. *Elisha Mitchell Sci. Soc., J.* 51. *pp.* 127–133, *Aug.*, 1935.—In view of the limitations and difficulties of

dimensional analysis, a simple and workable method is outlined which yields similar information. It consists in transforming the equations of a problem, differential or otherwise, so that all the variables are dimensionless ; inspection then shows how these are related, since the dimensionless variables and combinations of dimensional constants which occur in the final integrated form of the equations are exactly those occurring in the original differential equation and the boundary or initial conditions Hence, in some cases the method can make effective use of the physical information contained in initial and boundary conditions. The method is illustrated by considering the vibrations of a stretched wire. N. M. B.

457. Boundary Value Problem. M. J. Fish. *J. Math. Phys.* 14. *pp.* 262–273, *Sept.*, 1935.—The integrability conditions of the shearing stresses in the torsion of a ring sector give rise to an elliptic partial differential equation of the second order $\delta^2\phi/\delta x^2+\delta^2\phi/\delta y^2-(3/x)\delta\phi/\delta x=k$. This same equation arises in the analytical study of the effects of side leakage of oil in bearings and in the flow of electricity through a thin homogeneous plate of variable thickness. Particular solutions have been given by Mitchell, Timpe, Jacobson and Göhner. From the theory of elliptic differential equations the solution is unique. The author considers the actual determination of the solution and throws light on the differential equation involved. R. S. R.

458. Fourier Transform Solution of Ordinary and Partial Differential Equations. N. Levinson. *J. Math. Phys.* 14. *pp.* 195–227, *Sept.*, 1935.—Mathematical physical problems, *e.g.*, the long-line equation of current flow and the heat flow equation, are solved by means of the Fourier integral, ideas of operators being omitted entirely. Linear systems of equations are principally discussed ; the method is applicable to special types of non-linear equations. J. S. G. T.

459. Numerical and Mechanical Methods in Double Fourier Synthesis. J. M. Robertson. *Phil. Mag.* 21. *pp.* 176–187, *Jan.*, 1936. —Computational methods are described for the summation of double Fourier series particularly applicable to complicated crystal analysis. After a review of possible mechanical synthesisers the method favoured is a numerical one, assisted by a simple mechanical sorting device for the terms. Sine or cosine factors in steps of 6° of all the natural numbers from 1 to 1000 are written out on strips of cardboard. The sorting device then selects the required numbers and presents them in columns ready for addition. The method is fast, accurate to three figures, and the number of strips is a minimum, because each can be used either for a sine or a cosine factor, or for a positive or negative coefficient. An alternative device on the same principle is described. These arrangements have been used in computations involving over 250,000 terms. AUTHOR.

460. Uneven Probability Function. N. R. Wilson. *Roy. Soc. Canada, Trans.* 29. *Sect.* III. *pp.* 113–126, *May*, 1935.—Kelvin's deductive solution of the Gaussian law of errors is discussed in considerable detail, and it is shown that some of the rather liberal assumptions made in the deduction, more especially the assumption of evenness of the error function are unnecessary. J. S. G. T.

461. Theory of Measurement. N. Kryloff and N. Bogoliouboff. *Comptes Rendus*, 201. *pp.* 1002–1003, *Nov.* 25, 1935.—Assuming Ω is a metric compact space and $\phi(A)$ are the functions of the whole, not negative and absolutely additive for the ensemble (B) of Ω, then $\phi(A)$ can

be treated like the measurements in Lebesgue integrals. Applying this theory of measurements to the study of dynamical systems of non-linear mechanics it is shown that (1) from the whole infinite series of normalised measurements a converging series can always be extracted, and (2) as a corollary, if a series of normalised measurements ϕ_n admits only a single limited function ϕ then $\phi_n \underset{n \to \infty}{\to} \phi$. R. S. R.

462. Adoption of "M.K.S." (Giorgi) Absolute System of Units. *Journ. Télécommunications*, 2. *pp.* 285–287, *Oct.*, 1935.—The plenary meeting of the I.E.C. at Scheveningen and Brussels, June 1935, decided to adopt the system of four fundamental units, *viz.*, metre, kilogramme, second, and one of the practical electrotechnical units (coulomb, ampere, volt, ohm). The four "irrationalities" of the C.G.S. system are stated, *viz.*, duplication of units (electrostatic and electromagnetic), inconvenient magnitude, artificialities introduced by referring all physical units to three dimensions and the irrational introduction of the term 4π. The Giorgi metre-kilogramme-second system of units is exempt from all these objections. The advantages of the new system are indicated and a table gives the nomenclature and symbols of electrical and magnetic units in the M.K.S. system, and their dimensional equations. See also **A. E. Kennelly.** *Nat. Acad. Sci., Proc.* 21. *pp.* 579–583, *Oct.*, 1935. R. E. N.

463. Equations of Electromagnetism. J. Fischer. *Phys. Zeits.* 36. *pp.* 914–916, *Dec.*, 15, 1935.—The equations of electromagnetism can be written in a symmetrical form independent of units by using, instead of the constants ϵ_0 and μ_0 of the Heaviside equations, two general coefficients k_1 and k_2, which are evaluated in terms of the particular system of units used only in the case of numerical work. The symbols D and B must be regarded as mere abbreviations for ϵE and μH. P. V.

464. Fundamental and Derived Units. Part II. R. T. Birge. *Am. Phys. Teacher*, 3. *pp.* 171–179, *Dec.*, 1935.—A discussion of systems of electric units following the principles of Part I [Abstract 4477 (1935)], and emphasising the following points: (i) The choice of a system of units is primarily a matter of convenience. (ii) The number of units to be regarded as fundamental depends only on the defining equations adopted, and may vary with the nature of the problems to be dealt with. Thus, in the general theory of relativity, it is convenient to adopt defining equations leading to one fundamental unit; in classical physics it is more convenient to use three. (iii) The intrinsic character of a physical quantity has no necessary connection with the dimensions assigned to the unit of that quantity. (iv) The character of a physical quantity is a matter of philosophy, while the assigned dimensions of its unit are a matter of mere convenience, having only arithmetical significance. L. H.

***465. Coordirectograph for Curve Comparison. H. D. Green and J. Maurer.** *Rev. Sci. Instruments*, 7. *pp.* 37–40, *Jan.*, 1936.—A mechanical labour-saving device is described for converting two curves with differing ordinate and/or abscissal values to identical scales in the two axes, and for quantitatively subtracting such curves. Since the various uses of the appliance depend upon its ability to convert different ordinate values to the same scale, it is called a coordirectograph. AUTHORS.

See also Abstracts **833, 871.**

MECHANICS, CLASSICAL.

466. Equilibrium of Rotating Bodies. D. Wolkowitsch. *Comptes Rendus*, 201. *pp.* 1010–1012, *Nov.* 25, 1935.—The use of the ellipsoid of inertia to describe the additive property of solids is extended to the problem of the state of equilibrium of a rotating body. A body S is considered as the sum of two others S_1 and S_2 and E, E_1 and E_2 are the corresponding ellipsoids of inertia. An investigation is carried out of the following problem. A solid S_1 of mass m_1 is constrained to turn round an axis XX^1. An attempt is made to arrange a known system S_2, of given mass m_2, such that the axis XX^1 becomes the principal axis of the ellipsoid of inertia E of the solid $S = S_1 + S_2$. G. F. P. T.

See also Abstracts 439, 498, 561.

MECHANICS, QUANTUM.

467. Integration of Dirac's Differential System. A. Tonolo. *Accad. Lincei, Atti*, 22. *pp.* 30–33, *July*, 1935.—Relative to Dirac's system of differential equations in quantum mechanics, the author solves the following two problems : (1) To give the formulæ for Dirac's functions ϕ_i in the whole of space and for any value of the time t, supposing known the functions for $t = o$. (2) To give the formulæ for the functions ϕ_i at the internal points of a space enclosed by a surface S, and for any value of t, supposing known the functions ϕ_i throughout this space for $t = o$, and also the same functions on the surface S at any instant of time. A. J. McC.

468. Solution of the Dirac Equation for any Centrally Symmetrical Field of Force. F. Sauter. *Zeits. f. Physik.* 97. 11–12. *pp.* 777–784, *Nov.* 25, 1935.—Dirac's equation for the electron is solved by a method involving operators. In this method only the eigenvalues of the total momentum and of an operator involving the product of spin- and orbital-momentum, in addition to those of the energy, appear. The solution involves two functions of the radius vector which can be found once the potential of the field is given, and a generalised Legendre function. It is also shown how the solution can be specialised so as to involve the eigenfunctions and eigenvalues of one of the components of angular momentum. Finally the explicit expressions of the four components of the wave-function are given. G. C. McV.

469. Generalisation of Dirac's Method for Determination of Energy Levels of a System. V. G. Nevzgliadov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. *pp.* 347–350, 1935. *In German.*—The interaction energy of a many-electron system with weak interaction being expressed as a sum of permutation operators, it is shown how the effect on the energy levels of a further type of degeneracy can be calculated. G. C. McV.

470. Present Status of Quantum Mechanics. E. Schrödinger. *Naturwiss.* 23. *pp.* 807–812, *Nov.* 29 ; 823–828, *Dec.* 6, *and pp.* 844–849, *Dec.* 13, 1935.—A non-technical account is given of the present-day views on the basis of the quantum theory with particular emphasis on the nature of the knowledge of the external world which can be acquired in experiments. The character of the " probable " knowledge of a system which can be acquired is defined and it is shown how the mathematical apparatus of the quantum theory reproduces this " probability." The theory of physical measurement as an interaction between apparatus and object

is discussed and it is explained how maximum knowledge of a system does not necessarily imply maximum knowledge of the two or more parts into which the system may be supposed to be divided. The difficulty presented by the different proper times of the various parts of a system is discussed in relation to the relativistic extension of the quantum theory. G. C. McV.

471. Theory of the Hydrogen Atom. V. Fock. *Zeits. f. Physik*, 98. 3–4. *pp.* 145–154, *Dec.* 14, 1935.—The Schrödinger-equation of the H atom in the impulse space is shown to be identical with the integral equation of the spherical harmonic in four-dimensional potential theory. The transformation group of the H atom equation is thus the four-dimensional rotation group, and degeneration of the H levels is therefore to be explained in terms of the azimuthal quantum number. Relations derived from this interpretation of the Schrödinger equation have many physical applications. These are illustrated by reference to the Compton effect, expressions for the density matrix in the impulse space, atomic form factors and screening potentials. J. S. G. T.

472. Rotation of Molecules in Fields of Octahedral Symmetry. A. F. Devonshire. *Roy. Soc., Proc.*, 153A. *pp.* 601–621, *Feb.* 1, 1936.—The solution of Schrödinger's equation for a diatomic molecule rotating in a potential field having octahedral symmetry is discussed, firstly in the general case, and then when the field has a particular form. In the latter case the energy values are plotted against a parameter determining the strength of the field. AUTHOR.

See also Abstracts 431, 512, 666, 686, 687, 726.

RELATIVITY AND ETHER.

473. Motion of a Satellite about a Heavy Nucleus in the Special Theory of Relativity. J. L. Synge. *Roy. Soc. Canada, Trans.* 29. *Sect. III. pp.* 41–52, *May*, 1935.—The author deals with the problem of the motion of a satellite of negligible mass moving round a relatively heavy central nucleus, on the basis of his theory that the interaction between particles takes place by means of elementary impulses possessing energy and momentum and travelling with the velocity of light. The orbit under an inverse square law attraction is deduced as a first approximation. A second approximation yields an orbit with rotating apse-line, but the rotation is only 1/18th of the Einsteinian value. The theory is invariant for Lorentz transformations. G. C. McV.

SOLUTION.

474. Solubility of Mixed Gases in Water under Pressure. I. R. Kritschewsky, N. M. Shaworonkoff and V. A. Aepelbaum. *Zeits. f. phys. Chem.* 175. *Abt.A.* 3. *pp.* 232–238, 1935.—A thermodynamic method for the calculation of the solubility of mixed gases in liquids under pressure is developed. The theory assumes that a dissolved gas has no influence on the thermodynamic potential of another dissolved gas. It is tested by determination of the solubilities of CO_2 in admixture with H_2 in water at temperatures of 20° C. and 30° C. under pressures of 30 kg./cm.^{2}. The results agree with the calculated values. F. J. B.

475. Solubility of Lime in Water. G. L. Larocque and O. Maass. *Canad. J. of Research*, 13. *Sect.B. pp.* 276–279, *Nov.*, 1935.—The solubility

of lime is determined with a high degree of accuracy over the temperature range 0 to 30° C. by a conductivity method. The degree of dissociation of lime over this temperature range and over the concentration range 0 to 1·164 gm. of calcium oxide per l. is calculated. AUTHORS.

476. Solubility of Slightly Soluble Electrolytes. M. Haïssinsky. *Acta Physiochimica*, 3. 4. *pp.* 517–528, 1935. *In French.*—Values are given, as obtained by various authors, for the solubility of 14 simple inorganic substances (electrolytes of very low solubility) as measured by some or all of eight different methods. Results in every case show considerable disagreement, and the question is discussed as to how far this is due to experimental error, inherent unreliability of the method, formation of colloidal state, existence of different varieties of the substance, original method of preparation, and method and duration of storage. It is concluded that the solubility of slightly soluble electrolytes capable of precipitation in colloidal form cannot be regarded as true physical constants having a fixed significance. N. M. B.

See also Abstract 647.

SURFACE TENSION AND COHESION.

477. Surface Tension by Stationary Waves in Vertical Liquid Columns. J. Satterly and J. C. Strachan. *Roy. Soc. Canada, Trans.* 29. *Sect. III. pp.* 105–112, *May*, 1935.—The surface tensions of water and mercury are determined by means of the application of Lamb's theory to optical and photographic measurements of stationary waves in falling vertical columns of these liquids. For water, mean values of 73·4 and 72·4 dynes/cm. at 15° C. are found with two different jets and rates of flow. For freshly purified mercury the mean value 562 dynes/cm. at 20° C. is found, but the determined value appears to fall asymptotically to reach 495 dynes/cm. some weeks after purification. The method is free from dependence on contact angle and determines the surface tension instantly after formation of the surface, but the rate of flow and the dimensions observed in the liquid column are required to high precision. P. H. B.

478. Graphical Determination of Wetting Angle Relationships by Maximum Bubble Pressure. E. Lange and K. Nagel. *Kolloid. Zeits.* 73. *pp.* 268–269, *Dec.*, 1935.—In a recent paper [see Abstract 4490 (1935)], the most important phase limiting energies of systems consisting of pure phases were collected, and, in the present publication, a simple graphical process is described for the determination of wetting-angle relationships based on the surface energies given by the maximum bubble pressure method. H. H. Ho.

479. Surface Tension of Potassium and Lithium Salts of Fatty Acids by the Ring Method. Part II. A. Lottermoser and E. Giese. *Kolloid Zeits.* 73. *pp.* 276–288, *Dec.*, 1935.—Using the technique described in Part I [see Abstract 103 (1936)], surface tension-temperature relationships are re-established. The disturbing effect of the glass of the containing vessel becomes smaller with increasing temperature. The surface tensions of K and Li soaps show a steep fall at medium soap concentrations similar to that previously demonstrated for Na salts. The surface tension of the K salts of myristic, palmitic, stearic, and abietic acids decreases proportionately with the logarithm of the concentration. A comparison of Na, K, and Li salts shows that the kation has with certain exceptions, little influence on the surface activity. Very dilute K soaps

obey Traube's rule qualitatively. Of Li soaps the myristate shows the smallest surface tension. P. H. B.

480. Influence of Light on the Surface Tension of Soap Solutions. Part II. L. D. Mahajan. *Zeits. f. Physik*, 98. 5–6. *pp.* 388–395, *Dec.* 23, 1935.—In a previous investigation [see Abstract 4059 (1931)] the author has dealt with the influence of light on the surface tension of Boys' soap solution, and he now studies the lowering of the surface tension by light of different wave-lengths in the visible and u.v. region with respect to the concentration of the soap solution. The methods employed were those of weighing [see Abstract 1812 (1932)], size of drops, and the surface tension balance. The amount of lowering increases with dilution to a definite limit, and then declines on further dilution. The maximum decrease was observed at $6{\cdot}25 \times 10^{-4}$ gm. sodium oleate per c.c., but the limiting value above varies according to the age, purity, and nature of the soap used. Whereas the violet rays of the visible spectrum cause a considerable decrease in the surface tension of soap solutions, the largest decrease is produced by u.v. rays which are very strongly absorbed, this commencing at about 4000 Å. The conclusion is drawn that the decrease in surface tension is due to a chemical change produced in the soap solution by the violet and u.v. rays. This photo-effect is independent of heat or absorption and occurs where the latter effects are excluded. H. H. Ho.

481. Surface Tension near the Critical Point. A. W. Porter. *Phil. Mag.* 20. *pp.* 1163–1166, *Dec.*, 1935.—The behaviour of liquids in "capillary" tubes near the critical temperature is discussed. For a zero angle of contact and a very narrow tube, the surface is practically hemispherical but near the critical temperature the surface becomes almost flat; the change in shape of the surface becomes analogous to that found in wide tubes at normal temperature. The results of Bashforth and Adams and of Lord Rayleigh provide data for the study of the problem of what value of $\beta^2 (\beta = \sigma/g(\rho_s - \rho_n))$ will the capillary rise, h_0, become indistinguishable from zero. A table is prepared showing the values of h_0 and the radius of curvature at the centre for different values of β^2. It is not possible at present to find at what temperature h_0 vanishes since it is essential to know how β^2 varies with temperature. H. J. H. S.

482. Constitution of Surface Layers in Malachite Green Solutions. (Miss) M. T. Salazar. *Comptes Rendus*, 201. *pp.* 1120–1123, *Dec.* 2, 1935.—By drop-weight observations with solutions of malachite green the relation $\sigma - \sigma_s = aC^b$ (σ = surface tension of water, σ_s = that of solution, C = concentration in gm. per 100 cm.^{3}, $a = 15{\cdot}14$ and $b = 0{\cdot}26$) was established. Combining this with Gibbs' relation it follows that $U = 0{\cdot}39 \times 10^{-8} \times (\sigma - \sigma_s)$ where U = gm. adsorbed per 1 cm.^{3} at the air-solution interface. From U and the density of the malachite green the limiting thickness of the adsorbed layer is calculated to be $6{\cdot}97 \times 10^{-8}$ cm., which agrees well enough with the molecular diameter $8{\cdot}94 \times 10^{-8}$ cm., thus demonstrating that Gibbs' relation is applicable to the surface layer and that the surface layer is monomolecular. P. H. B.

483. Methods of Investigation of Monomolecular Films. I. Langmuir and Katharine B. Blodgett. *Kolloid Zeits.* 73. *pp.* 257–263, *Dec.*, 1935.—This paper contains very detailed descriptions of methods for the production and investigation of monomolecular films, and in particular of processes in which the film is prepared on a solid surface (*e.g.* of glass and metals) whereby its mechanical properties can be tested. H. H. Ho.

484. Velocity of Large Bubbles in Vertical Tubes. M. P. O'Brien and J. E. Gosline. *Indust. and Engin. Chem.*, 27. *pp.* 1436–1440, *Dec.*, 1935.—The rise of air bubbles in water and in two colourless petroleum oils is observed in vertical glass tubes of dia. 1·18, 2·24, and 6·00 in. The 6-in. tube was 26 ft. long. The bubble sizes are above those for which Stokes' law is valid. The results obtained for bubbles of dia. about 1/8 in. are in reasonable agreement with those of earlier workers. Disagreement below this size is attributed to a condition similar to the transition from laminar to turbulent flow in pipes. The Gibson formula for the limiting velocity attained with increase in bubble volume gives slightly high values for small tubes, and low values for large tubes. P. H. B.

See also Abstracts 387, 431, 439, 756, 762.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

***485. Angle Converters and Meters. H. Maurer.** *Zeits. f. Instrumentenk.* 55. *pp.* 448–456, *Nov.*, 1935.—Disadvantages of various systems of angular measurement, *e.g.*, in terms of radians, degrees, minutes, seconds, etc., are briefly referred to, the applications of such systems in military and naval science being, *inter alia* referred to. The advantages of a system in which 2π radians is divided into 6000 units, are pointed out. The term " set " (derived from *sechs* and *tausend*) is suggested for the new unit. Devices for interconversion of the various scales are described and their use exemplified. J. S. G. T.

***486. Calibration of Circular Scales. F. Hauer.** *Zeits. f. Instrumentenk.* 55. *pp.* 456-464, *Nov.*, 1935.—Apparatus for the determination of periodic and other errors in circular scales is described and illustrated. J. S. G. T.

See also Abstract 766.

VACUA, HIGH.

***487. Valve Pressure Regulator. V. Kunzl and J. B. Slavik.** *Ann. d. Physik.* 24. 5. *pp.* 409–420, *Nov.*, 1935.—The use of a valve for regulating gas pressures consisting of a fine slit instead of the more usual capillary tube is discussed. The slit considered is 2·3 cm. long and 0·1 cm. wide, and is cut in a glass tube of outer diameter 1·95 cm. and inner diameter 1·75 cm. The rate of gas-flow for various pressures and pressure-differences is measured, and the results are tabulated. The results are compared with theoretical values from Poiseuille's and Knudsen's formulæ, and it is shown that even at the lower limits of pressure (Ca. 200 mm.) Poiseuille's formula holds. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

488. Microscopic Measurement of the Viscosity of a Liquid. F. Hirata. *Chem. Soc., Japan, Bull.* 10. *pp.* 507–524, *Nov.*, 1935.—Fine solid particles are uniformly dispersed in the liquid whose viscosity is to be measured and the suspension is made to flow under a definite pressure in a capillary tube of definite radius and length. The velocity of flow on the axis of the capillary tube is measured directly by a microscope and thus the absolute viscosity is determined. The theory is discussed and experimental details are given. The viscosities of glycerin and acetone solutions

of cellulose acetate are measured and are in good agreement with those obtained using the Ostwald viscometer. W. R. A.

***489. Logarithmic Head Correction in Viscometry. G. Barr.** *Chem. Soc., J. pp.* 1793–1795, *Dec.*, 1935.—After giving (*a*) rigid and (*b*) simplified expressions with a view to facilitating calculation of the logarithmic head for glass viscometers of various common designs, the application of the correction in the standardisation of Ostwald viscometers is discussed in some detail. Finally, some remarks are made on the use of the correction in the examination of "abnormal" liquids. P. H. B.

490. Viscosity of Deuterium Oxide and Its Mixtures with Water at 25° C. G. Jones and H. J. Fornwalt. *J. Chem. Phys.* 4. *pp.* 30–33, *Jan.*, 1936.—The viscosity, η, of 97·6 % D_2O and six more dilute mixtures with water, as well as that of nearly pure protium oxide, is determined by comparison with ordinary water, and found to be almost but not quite a linear function of the specific gravity. The relative fluidity, ϕ, is related to the density by an equation of the type $\phi = 1/\eta = 1 + A(\Delta s) + B(\Delta s)^2$, where (Δs) is the increase in the specific gravity over ordinary water. This equation is found to be valid to 0·006 % over the entire concentration range. Bingham's equation concerning the law of additive fluidities in binary systems, and containing but one arbitrary constant, is tested and found to be valid to 0·01 %. AUTHORS.

491. Viscosity of Gases. A. Fortier. *Comptes Rendus*, 201. *pp.* 1330–1332, *Dec.* 23, 1935.—The gas issues from a reservoir under pressure P, through a capillary of length l and radius r, into a chamber C, in which its pressure is $P - \Pi$. It then passes by a small tube of cross-section S, into a second chamber where the pressure is $< 0{\cdot}52\ (P - \Pi)$. The equation $\Pi = K(1 - K/2P)$ then holds, where $K = 8\mu Tl/S\{2/(1+\gamma)\}^{1/(\gamma-1)}.\ \{2\gamma R/(1+\gamma)\}^{\frac{1}{2}}/\Pi\Theta r^3(r + 4\epsilon)$, μ is the coefficient of viscosity, T and Θ the absolute temperatures of the gas in the capillary and C respectively, ϵ the thickness of slip, and γ and R have their usual meanings. P may be ordinary atmospheric pressure, and Π of the order of 10 cm. of H_2SO_4. C. A. S.

492. Non-Freezing Mineral Lubricants. Y. Tanaka, R. Kobayasi and T. Tukuda. *Imp. Acad. Tokyo, Proc.* 11. *pp.* 342–344, *Oct.*, 1935. *In English.*—A non-freezing lubricating oil is produced by adding hardened fatty oils to a freezing mineral lubricating oil. The saturated monobasic fatty acids exert the same effect. AUTHORS.

See also Abstracts 382, 383.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***493. Observations of Intensity with a Spectrohelioscope. R. v. d. R. Woolley and H. W. Newton.** *Roy. Astron. Soc., M.N.* 96. *pp.* 5–15, *Nov.*, 1935.—An attachment to the spectrohelioscope is described, by means of which intensities of bright flocculi and prominences may be referred to the intensity of the solar disc outside the line $H\alpha$ or $H\beta$. The contour of $H\alpha$ is determined with this apparatus, without photographic photometry. The most frequent intensity of non-eruptive flocculi in $H\alpha$ is 0·30 of the intensity of the neighbouring disc at wave-lengths outside $H\alpha$, eruptive flocculi being brighter. Prominences are measured in both $H\alpha$ and $H\beta$. Non-eruptive prominences in $H\alpha$ show a most frequent intensity of 0·10 of the intensity of the centre of the disc outside $H\alpha$. Eruptive prominences are much brigher. The ratio of intensity of $H\beta/H\alpha$ averages 0·26 when both are referred to the centre of the disc, but this decrement appears to vary from one prominence to another. AUTHORS.

***494. Stellar Spectrograph for the 74-in. Toronto Reflector.** *Engineering*, 140. *pp.* 638 *and* 643–644, *Dec.* 13, 1935.—This instrument is specially designed by Dowell of Adam Hilger, Ltd., for measuring radial velocities of stars. It is 7½ ft. long, and the tubes for collimator and camera are eliminated, the functions of these parts being performed by the spectrograph body itself. The outer casing is lined with thick felt on which are electrical heating wires, and the supply of current to these is controlled so as to keep the temperature constant at about 10° above that of the atmosphere. Diagrams and photographs show all the details of construction, method of mounting, and various accessories, which include comparison arc and condenser, guiding and viewing telescopes, and a camera for taking direct photographs of stars. M. A. E.

COMETS AND METEORS.

495. Orbit of Comet 1935a (Johnson). M. Pierucci. *N. Cimento*, 12. *pp.* 503–504, *Aug.–Sept.–Oct.*, 1935.—In 1921 and 1927 the author drew attention to the fact that the areas within the elliptical orbits of periodical comets are equal to those within the orbits of the asteroids or of Saturn. Comet Johnson has an almost parabolic orbit whose area is exceedingly close to that of Neptune's orbit. This suggests that the place of origin of all comets belonging to the solar system should be sought among the asteroids and the least dense of the major planets. M. A. E.

COSMOGONY.

496. Expanding Universe. L. Silberstein. *Roy. Soc. Canada, Trans.* 29. *Sect.* III. *pp.* 1–4, *May*, 1935.—The author criticises the linear increase of red-shift with distance in the spectra of spiral nebula,

firstly, on the ground that the observational data are not accurate enough to ensure the linearity of the increase, and secondly, on the ground that the relativistic expanding universe models predict (for the particular definition of distance adopted by the author) non-linear dependence on distance for the red-shift. No reliable estimate of the magnitudes of the non-linear, as compared with the linear, terms is given. G. C. McV.

497. Steadily Expanding Universe and the Spiral Structure of the Nebulæ. V. V. Narlikar and D. N. Moghe. *Observatory*, 58. *pp.* 366–368, *Dec.*, 1935.—It is pointed out that if a positive pressure is created in an Einstein universe, this universe will start expanding. It is also noted that every expanding universe possesses geodesics which are spirals in terms of cosmical coordinates. G. C. McV.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

498. Effect of a Variation of Mass on a Planetary Orbit. D. Graffi. *Accad. Lincei, Atti*, 22. *pp.* 55–59, *July*, 1935.—In a previous paper [see Abstract 3346 (1935)] it was shown that a continuous fall of particles upon a planet caused sensible variations in the eccentricity of the planet's orbit. The present paper continues the discussion of the variation in eccentricity when there is not only a fall of particles on the planet, but also a continuous emission of particles from the planet, and a formula for this variation is given when certain simplifying hypotheses are introduced. A. J. McC.

NEBULÆ.

499. 7900 External Galaxies. H. Shapley. *Nat. Acad. Sci., Proc.* 21. *pp.* 587–592, *Nov.*, 1935.—A survey of 174 square degrees of the Southern Galaxy in Dorado, Horologium and Reticulum. A figure shows the distribution of the 7900 galaxies and indicates that for the large region there is a greater density than is usual for average density; even outside the clusters, the number of galaxies per square degree in the Horologium region is approximately twice the average of those in the Harvard and Mt. Wilson studies. A sudden increase in the numbers of photographic magnitudes between 15·5–17·0 indicates a metagalactic cloud, whose distance (if the size of its members is normal) is about 22 megaparsecs. The evidence is strong that this cloud is real and not due to error in the magnitudes scale. 90 % of the nebulæ have diameters of 0′·2 to 0′·5. In this congested region there seems a genuine correlation between intrinsic brightness and linear size. A. S. D. M.

500. Colours and Spectra of External Galaxies. F. L. Whipple. *Harvard Coll. Obs., Circ. No.* 404. [10 *pp.*], 1935.—38 external galaxies in the Como-Virgo region give colour indices corresponding to an average 11th magnitude star of G 7·5 type, and are determined from near stars of known spectral types. Of these a table and diagrams are given. The author uses van Rhyn's data to make a galactic cross-section near the sun, and this gives a colour index of + 0ᵐ·57, and an apparent spectral type, F2, very like the globular cluster N.G.C. 7078; this is bluer than the sun, and may indicate that the sun is at a considerable distance from the centre of a spiral nebula. The line profiles in the composite spectra of the nebulæ are wide and shallow, and these depend upon the frequency distribution of spectral types, while the distribution of energy in the

continuous spectrum depends upon the frequency distribution of temperatures ; were the intensity variation of certain lines with absolute magnitude known, the complete problem might be solved by line profiles alone. There seems to be no space-reddening effect in external galaxies near the galactic pole, nor such effect between these, due to dark scattering material. A. S. D. M.

501. Apparent Radial Velocities of 100 Extra-Galactic Nebulæ. M. L. Humason. *Mt. Wilson Observat. Contrib. No.* 531. *Astrophys. J.* 83. *pp.* 10–22, *Jan.*, 1936.—New velocities of 100 nebulæ are given. With the exception of 6, they are all velocities of recession ranging from + 50 km./sec., for a member of the Virgo Cluster, to + 42,000 km./sec. for a member of the Ursa Major Cluster No. 2. In the Virgo Cluster 25 new velocities have been obtained, 9 of them by S. Smith. These, with velocities previously known, show an average range of 500 km./sec. around a mean of + 1200 km./sec. Magnitudes range from 10·0 to 15·0. The mean velocity of the fainter members is approximately the same as that of the brighter. Late-type spirals (Sc) are decidedly bluer than E, Sa, or Sb nebulæ. The mean spectral type for these groups is : Eo-7, G3·6 ; Sa, G3·4 ; Sb, G1·6 ; Sc, F8·8. Velocities of the order of + 40,000 km./sec. have been observed in the Boötes Cluster and in the Ursa Major Cluster No. 2. These values are consistent with estimates of the distance by Hubble and Baade (about 70 million parsecs. for both clusters) and indicate that the velocity-distance relation is still sensibly linear to this distance. [See following Abstract.] AUTHOR.

502. Mass of the Virgo Cluster. S. Smith. *Mt. Wilson Observat. Contrib. No.* 532. *Astrophys. J.* 83. *pp.* 23–30, *Jan.*, 1936.—The lists of radial velocities now include results for thirty-two members of the Virgo Cluster [see preceding Abstract], thus giving for the first time sufficient data to determine some of the physical characteristics of a cluster of nebulæ. A comparison of the velocities of fainter members of the cluster with those of brighter members shows that the line-of-sight velocity of a nebula has no dependence on its magnitude ; hence, equipartition apparently does not hold in the cluster. The distribution of the velocities in right ascension and declination shows that the cluster is not in rotation and that there is no central concentration of high velocities. This result is taken to mean that the cluster is neither condensing nor breaking up, but is a fairly stable assemblage, more or less held together by its gravitational field. From the observed distribution function for radial velocity is derived the distribution function for space velocity. For an assumed distance of 2×10^6 parsecs. this function leads to 2×10^{47} g or 10^{14} ⊙ as a value of the mass of the cluster. On the basis of 500 nebulæ in the cluster, the mass per nebula is 2×10^{11} ⊙. Although far larger than Hubble's value of 10^9 ⊙ for the mass of an average nebula, other evidence lends support to the high value obtained from the Virgo Cluster. It is possible that both figures are correct and that the difference represents a great mass of internebular material within the cluster. AUTHOR.

See also Abstract 497.

PLANETS.

503. Empirical Law in the Solar System. M. Pierucci. *N. Cimento*, 12. *pp.* 505–509, *Aug.–Sept.–Oct.*, 1935.—It has been shown in previous notes that the distances of the major planets, expressed in units

of earth's semi-major axis, and dividing them into two groups of inner and outer planets, are in the proportion 1,2,3,4, and 1,2,4,6. The discovery of Pluto, with a semi-major axis of 8, confirmed the rule, and it holds also for the satellites of Mars, and those of Jupiter and Saturn divided into inner and outer groups. The distances of periodic comets, and the discovery of a minor planet with cometary orbit, bring these bodies also within the scheme. A similar law relates planetary mass and distance with their "total energy." Distances are calculated at which possible ultra-Plutonian planets may be found. M. A. E.

504. Meridian Observations of Uranus and Mars. L. Gialanella. *Accad. Lincei, Atti*, 22. *pp.* 325–330, *Oct.*, 1935.—Continuing the observations of major planets begun in 1934 at Campidoglio Observatory, tables of R.A. and Dec. of Uranus are given for 1934 (Nov. 30) to 1935 (Jan. 1), and of Mars for 1935 (May 1 to 20). The observed positions are compared with those predicted in the Nautical Almanac. M. A. E.

505. Mean Movement of Pluto. H. Roure. *Comptes Rendus*, 201. *pp.* 1322–1323, *Dec.* 23, 1935.—A better value of the mean movement of Pluto than that hitherto available is deduced from observations recorded by various observers extending over the last 20 years. The most probable value is found to be 13·483″. J. E. K.

See also Abstracts 498, 533.

STARS.

506. Stellar Parallaxes Determined at the Royal Observatory, Greenwich. *Roy. Astron. Soc., M.N.* 96. *pp.* 111–114, *Nov.*, 1935.—A continuation of the results obtained with the 26-inch Thompson refractor [see Abstract 629 (1935)].

507. Stellar Parallaxes Determined Photographically at the Cape Observatory. (Seventh List.) *Roy. Astron. Soc., M.N.* 96. *pp.* 115–118, *Nov.*, 1935.—A continuation of previous lists [see Abstract 630 (1935)].

508. Variable Spectrum of γ Cassiopeiæ. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 96. *pp.* 2–4. *Nov.*, 1935.—From 1934 Dec. 20—1935, July 27, the violet component has brightened up in relation to the red in *all* hydrogen lines; since July 27, the line Hζ is excepted and its violet component has vanished altogether (save a faint trace on Sept. 10) until 1935, Oct. 7, when in this line the place of the violet has been taken by the strongest and sharpest absorption line in the spectrum. To this absorption, the author attributes the vanishing of the Hζ violet component. Similar behaviour in the same line is found in the Be star ϕ Persei, and in other Be stars for the line Hϵ, the absorption in these latter being due to Ca^+. [See Abstract 2891 (1935).] A. S. D. M.

509. Selective Absorption and Colour Change of c Stars. W. Becker. *Zeits. f. Astrophysik*, 11. *pp.* 98–112, *Dec.* 15, 1935.—For the B-star colour-indices (Babelsberg, Washburn and Yerkes), selective absorption coefficients for individual stars are derived (distance determination from spectrum and absolute and apparent brightnesses without regard to general absorption in space), and their spherical distribution is studied. Regions of equally strong selective absorption are limited. Selective absorption coefficients fluctuate between 0·0 and 0·5 m. per 1000 pc. for 4260 and 4770 Å. There is no clear relation between selective absorption and star-density, and no causal connection between selective

absorption and Ca line intensity. If the B-star colour-indices are reduced to null distance the otherwise very wide spread of the relation between colour-index and spectrum is diminished to about one-fifth. The λ-law of the yellow colour change of the super-giants is not the same for B stars as for later types; the former have large positive colour excess in all regions from blue to infra-red; the latter only in the blue. In the cB stars and the yellow B stars alone the selective interstellar absorption is responsible for the colour change. In the cG and cK stars the colour change is a property of the stellar radiation itself. It is supposed that the sun is in a narrow drift of interstellar material whose selective absorption is 0·4 m. per 1000 pc., extending from the Taurus direction to the opposite point. W. J.

510. Spectra of Early-Type Stars in the near Ultra-Violet Region. P. Swings and M. Désirant. *Astrophys. J.* 83. *pp.* 31–46, *Jan.*, 1936.—The spectra of three B stars and of eleven A stars have been measured for wave-lengths in the region 3570–3930 Å. Identifications are made for most of the lines, and a discussion of the behaviour of the elements is given. AUTHORS.

511. Polytropic Character of Stellar Radiative Equilibrium. G. Tiercy. *Arch. des Sciences*, 17. *pp.* 340–360, *Sept.-Oct.*, 1935.—The paper deals with the theory of stellar models in which the temperature depends on the distance from the centre (r) and the density (ρ), according to the law $T = \theta(r) \cdot \rho^{k-1}$, where $\theta(r)$ is a function determined so that the model is polytropic, *i.e.*, so that the total pressure is related to the density by the equation $P = C \cdot \rho^k$. C is a constant depending on the values of β and T at the centre of the star and also on physical constants. The stellar models studied by Eddington and Milne arise as particular cases of the present models when special values are given to k. G. C. McV.

512. Relativistic Degeneracy. A. S. Eddington. *Roy. Astron. Soc., M.N.* 96. *pp.* 20–21, *Nov.*, 1935.—The proof of the formula for a relativistic degenerate gas put forward by Chandrasekhar and Møller [see Abstract 4146 (1935)] is criticised on the ground that they assume that the momentum of an electron confined in a finite volume can take on discrete values. This is held to contradict the uncertainty principle especially as the consecutive discrete values assigned to the momentum differ by an amount approximately equal to the uncertainty in the momentum produced by the fact that the electron's position is known, since it is within the given finite volume. G. C. McV.

513. Radiative Equilibrium of the Outer Layers of a Star with Special Reference to the Blanketing Effect of the Reversing Layer. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 96. *pp.* 21–42, *Nov.*, 1935.—The theory of the radiative equilibrium of the outer layers of a star is extended to include the formation of absorption lines in the reversing layer immediately above the photosphere. A fairly rigorous treatment is given based on the assumption that absorption lines occur uniformly in the whole spectral range. Plaskett's observed high value for the true colour temperature of the sun is accounted for. The departures of the observed law of darkening from the standard darkening (with a coefficient $u = 0 \cdot 6$) are also explained by considering a "scattering" atmosphere placed above a region of local thermodynamic equilibrium. G. C. McV.

514. Stability of Gaseous Stars. Part II. T. G. Cowling. *Roy. Astron. Soc. M.N.* 96. *pp.* 42–60, *Nov.*, 1935.—The theory of convective equilibrium of stars is developed with special reference to stability.

The general equations of the problem are found and from them are deduced the equations for an "equilibrium" configuration. By this is meant a state in which the mass velocity of the gas is zero, but turbulent velocity exists. The consideration of small oscillations about such an equilibrium configuration leads to the conclusions that gaseous stars in convective equilibrium are stable unless the ratio of the specific heats of the material is nearly equal to the critical value 4/3 or unless the rate of energy-generation increases extremely rapidly with temperature. Incidentally, it is shown that if Atkinson's theory of energy-generation is adopted, in which the energy-generation depends on the twentieth power of the temperature, then stability is possible if the ratio of specific heats is greater than 1·44 and if convective equilibrium is postulated. [See Abstract 3597 (1934).] G. C. McV.

515. Convection in the Interior of Stars. L. Biermann. *Astron. Nachrichten*, 257. *pp.* 270–294, *Dec.*, 1935.—The transport of radiation by convection of matter in stellar interiors is discussed, the convection taking place as soon as the temperature-gradient exceeds the adiabatic gradient. Convection may arise either through dependence of energy-generation on temperature or density, or through the massiveness of the star, or through ionisation. It may also be caused by large values of the energy generation and the opacity. The standard model (constant energy-generation and opacity) is discussed and shows that perfect gas stars will, in general, have an inner core where energy will be transported mainly by radiation, surrounded by turbulent shells in which convection-transport will preponderate. Eddington's model is the limiting case of such convective models. A completely turbulent model, in which there was no radiation transport, would be secularly unstable. Eddington's mass-luminosity law holds for such convective models. Models with Kramer's opacity law are also discussed and lead to similar conclusions. The theory provides an alternative theory to that proposed by Milne in which non-turbulence was postulated, but the central parts of the model consisted of degenerate matter. G. C. McV.

516. Percentage of Dwarfs Among Faint G and K Stars in High Galactic Latitudes. B. J. Bok. *Harvard Coll. Obs., Circ. No.* 400. [16 *pp.*], 1935.—Precise percentage of dwarfs among giants in G and K stars is needed for the knowledge of faint star spectra. From star ratios for successive magnitudes in the Yale Zone Catalogues, Schilt found that all faint G stars are dwarfs, and van Rhyn from observed secular parallaxes of G and K stars that only 50 % of the 9th magnitudes G stars in high galactic latitudes are dwarfs. The author explains his method of estimating the percentage from the distribution of total proper motions, and finds for $m_{pg} = 9{\cdot}0 - 10{\cdot}0$ in high galactic latitudes that 55 are dwarfs for the G stars and 13 for the K stars, thus agreeing closely with van Rhyn. A. S. D. M.

517. Absorption of Light in Interstellar Space. D. Barbier and V. Maître. *Comptes Rendus*, 201. *pp.* 1170–1172, *Dec.* 9, 1935.—A sketch of a method is given for calculating the space-absorption of light, using only the distribution function of the absolute magnitudes of the stars considered. G. C. McV.

518. Diffusion of Light in the Galaxy. Wang Shih Ky. *Comptes Rendus*, 201. *pp.* 1326–1328, *Dec.* 23, 1935.—The equation formulated by Dufay [see Abstract 570 (1936)] for the brightness of successively diffused radiation is developed and leads to the conclusion that the brightness due to

diffusion of stellar radiation in the galaxy can amount to one-half of that which is provided directly by the stars. J. E. K.

519. Direction of Star-Streaming in Galaxy. O. Heckmann. *Roy. Astron. Soc., M.N.* 96. *pp.* 67–68., *Nov.*, 1935.—The treatment is mathematical. The author concludes that the deviation of the vertex to the centre of the system is only possible in two very special cases. For if the force is arbitrary, there is only streaming in circular stream-lines around the centre, and one of the axes of the velocity ellipsoid is always directed radially. [See Abstract 4148 (1935).] A. S. D. M.

520. Direction of Star-Streaming. B. Lindblad. *Roy. Astron. Soc., M.N.* 96. *pp.* 69–77, *Nov.*, 1935.—It is shown that the coefficients of differential galactic rotation and expansion given by Ogrodnikoff for the B stars are not in numerical agreement with Shiveshwarkar's theory of the vertex deviation of star-streaming [see Abstract 4148 (1935)]. A vertex deviation in the direction of increasing galactic longitude demands a slight contraction of the material in question. A theory of the vertex deviation in principle similar to that of Shiveshwarkar, but starting from the theory proposed by the present author in which the velocity distribution is considered as a combination of the " natural " velocity ellipsoid with streams of matter emanating in asymptotic spiral orbits from the dense nuclear regions of our system, is developed. This leads to particularly simple formulæ for the differential effects which stand in good agreement with observation, especially with the second harmonic terms in the proper motions in α and δ. The probable significance of the difference in state of motion between the B-type stars and the stars of later types is discussed.

AUTHOR.

521. Angular Diameters of Globular Clusters. H. Shapley and A. R. Sayer. *Nat. Acad. Sci., Proc.* 21. *pp.* 593–597, *Nov.*, 1935.—Tracings of 70 globular clusters have been measured (generally in two position angles) with a Moll densitometer, and on a magnification of 5·4 over the original negative ; the angular diameters are given in a table. Many of the denser central portions show oblateness. No correction for space absorption could be given, so that the new diameters are valuable for revision only in the higher galactic latitudes ; since there is unevenness of absorption with longitude and latitude, there is little correlation with Stebbins' formula. A curve is given for diameters plotted against distance in kiloparsecs, and the dispersion is small ; a study of the deviations shows no systematic relation of these to class of cluster or to galactic latitude which is unexpected, and perhaps indicates that the angular diameter and apparent total brightness are equally undermeasured wherever the absorption is serious. A. S. D. M.

522. Galactic Rotation of Globular Clusters. H. Mineur. *Roy. Astron. Soc., M.N.* 96. *pp.* 61–67, *Nov.*, 1935.—The author represents the radial velocity (V) of a globular cluster (M) round the Oz axis, where O is the centre of the galaxy, taken as 10,000 parsecs distant towards longitude 326°, as $V = ar + br^2 + crz^2$, where a,b, and c are constants ; the term ar gives the angular rotation of the globular system near the sun and mingles with the terms of the sun's translation in $\rho = -(X + ay_0) \propto -(Y - ax_0)\beta - \gamma Z + br(\beta x - \alpha y) + cz^2(\beta x - \alpha y)$. He gives a diagram and table for 17 clusters whose $r < 2$; he concludes that a (which gives the rotation) must be considerable, and gives two methods for determining a. He finds that $V = -550\sqrt{} + 240r^2 + 280rz^2$, and for globulars within 20,000 parsecs round the galactic centre $= -0{\cdot}0550$ km.,sec.$^{-1}$,

parsec^{-1}, its absolute value decreasing at increasing distance from the centre and galactic plane, going down to zero at 20,000 parsecs from the centre in the plane and at about 10,000 parsecs from the plane; fitting in with the known constants of the galactic rotation of the stars around us. A. S. D. M.

523. Surface Distribution of Larger Magellanic Cloud Stars Brighter than 14 Photographic Magnitude. S. W. McCuskey. *Harvard Coll. Ob., Circ. No.* 401. [13 *pp.*], 1935.—35 regions covering about 215 square degrees have been counted for stars of apparent photographic magnitude 9-14, and corrected for distance from plate centre, atmospheric extinction, and statistical error. These confirm the increased size of the cloud already obtained from microphotometric tracings, and star cluster distribution. The cloud seems nearly circular (north-south diameter 10°·1; east-west, 11°) perhaps slightly flattened in the north to south direction. Stars of absolute magnitude $-6{\cdot}1 (m = 11{\cdot}0)$ yield a diameter in agreement with that from the absolutely fainter stars. A. S. D. M.

524. New Southern Double Stars. R. A. Rossiter, H. F. Donner and M. K. Jessup. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 63. 3. *pp.* 51–53, 1935.

525. Variable Stars of Short Period. Part II. XX Cassiopeiæ. S. Gaposchkin. *Harvard Coll. Obs., Bull. No.* 900. *pp.* 13–18, *Sept.* 1, 1935.—The periods derived by Leiner in 1922–24 and by Pagaczevsky in 1925–32, differ and the author confirms the latter from plates taken in the red (90 observations), yellow (70) and blue (247) that the light curve is of non-elliptical components. He finds that the components are similar in spectrum but different in surface brightness. The field is in Schalén's "bright region" where "the large colour indices can ... be explained through the assumption of a selective absorption depending on distance," and this is confirmed. The "irregular variable" XZ Cassiopeiæ is on the same plates, but the author cannot confirm its variability, which he considers is suggested by the extreme red colour of the star. [For Part I see Abstract 2453 (1935)]. A. S. D. M.

526. Density Gradient, Density, and Mass of the Atmosphere of ζ Aurigæ. S. Gaposchkin. *Harvard Coll. Obs., Bull. No.* 900. *pp.* 18–23, *Sept.* 1, 1935.—ζ Aurigæ is an eclipsing star, consisting of a B component and a supergiant K component with a large atmosphere; there is a decrease and increase of brightness before and after eclipse, each amounting to $0^m{\cdot}07$, affording a criterion for determination of the density, the density gradient, and the mass of the K component atmosphere. For the extinction effect, the author gives the equation, $I_1 = I_0\, e^{-kp\int ds}$, where the transmission coefficient, $p = e^{-k} = 0{\cdot}9$ is found from the mean density obtained by Christie and Williams. This mean density is $2{\cdot}4 \times 10^{-14}$ gm./cm., and the density near the photosphere is about three times this. The total mass of the atmosphere is 0·2 the earth's mass. A. S. D. M.

527. Investigation of Nordmann-Tikhoff Phenomenon by Colour-Photometry of Eclipsing Variables. P. Skoberla. *Zeits. f. Astrophysik*, 11. *pp.* 1–58. *Nov.* 17, 1935.—Twelve eclipsing variables are measured photometrically with colour filters to investigate the Nordmann-Tikhoff phenomenon [see Abstracts 590 and 591 (1908)]. The observations show a remarkable connection, which requires closer examination, between the magnitude of the effect and the brightness of the extra-focal star-disc. Other observers' results are collected and discussed, comparable observations are reduced to a common wave-length interval of 5000–6000 Å, and

the Purkinje-Gallissot effect is reviewed. The reduced temporal shift D of the minimum decreases with reddening of the eclipsing star, with absolute brightness of the two components, and with the absolute colorimetric difference of brightness of the components. However, the three supergiants S Ori, X Tau and CC Ori show the opposite behaviour. The observed shift increases fairly linearly with stellar distance. D of the galaxy (reduced to equal distances) probably depends upon especially dark spaces or clouds in interstellar space. The temporal shifts are attributed to rapidly varying dispersion of interstellar clouds of metallic particles with wave-length. W. J.

528. Early Nebular Stage and Hypothetical Parallax of Nova Herculis. B. Vorontsov-Velyaminov. *Zeits. f. Astrophysik*, 11. *pp.* 145–147, *Dec.* 15, 1935. *In English.*—The nebular stage of N. Herculis is described. Parallax based on the assumption of expansion hypothesis leads to a distance 1320 parsecs. and absolute magnitude at maximum $-9{\cdot}3$. AUTHOR.

529. Analysis and Interpretation of the Nebular Spectrum of Nova Herculis. Marie Bloch and J. Dufay. *Comptes Rendus*, 210. *pp.* 1463–1465, *Dec.* 30, 1935.—The photographs of the spectrum were taken from 18 Oct. to 14 Nov., 1935. They show a faint continuous spectrum and some sixty very bright lines which are classified into the permissible and forbidden lines and briefly described. The spectrum as a whole is very similar to the typical planetary nebula spectrum and can be interpreted in the same way. The main part of the energy in the continuous spectrum is emitted in the deep ultra-violet. G. C. McV.

See also Abstracts 494, 501, 502, 535.

SUN.

530. Cellular Vortex Theory of Superficial Solar Photosphere. H. Bénard. *Comptes Rendus*, 201. *pp.* 1328–1330, *Dec.* 23, 1935.—The striking analogy between the granulations of the photosphere as photographed by J. Janssen and the author's earlier publications concerning polygonal cellular vortices is discussed. The various granulation forms and groups which appear on Janssen's plates are shown to be in detailed qualitative and rough quantitative agreement with the polygonal vortex theory of their formation. Reference is also made to investigations of the forms of granulation made by Stoebel [see Abstract 3986 (1933)], who concluded that they were undoubtedly polygonal. It is concluded that the extreme photospheric layer, which is the only one where convection currents can exist, must consist of a layer of semi-regular polygonal cellular vortices. J. E. K.

531. Intensity of Hβ in the Chromospheric Spectrum. P. C. Keenan. *Astrophys. J.* 83. *pp.* 47–54, *Jan.*, 1936.—Direct photographic measurements made outside of eclipse give a value of 5×10^{10} ergs/cm.^{2}/sec. for the energy emitted over a hemisphere in the chromospheric line Hβ by a column of gas in the line of sight passing about 2000 km. above the photosphere. From this measure the density of H atoms in the fourth quantum state at the same height is computed as 7 atoms/cm.^{3}, agreeing in order of magnitude with the eclipse results of Pannekoek and Minnaert. The influence of self-absorption is discussed, and it is concluded that observations at 2000 km. are not seriously affected by this factor. AUTHOR.

532. Radial Motions of Prominences. P. C. Keenan. *Astrophys. J.* 83. *pp.* 55–60, *Jan.*, 1936.—Maximum radial velocities of prominences observed between 1930 and 1935 show no marked preference for either approach or recession. The majority lie between 30 and 70 km./sec., with an average of 53 km./sec. High positive and negative speeds frequently appear nearly simultaneously in adjacent parts of the same prominence. A tentative division into three types is suggested for prominences which develop large radial motions. By the use of a motion-picture camera on the spectrohelioscope it is possible to record velocity shifts. Such films can provide all the data necessary for the construction of the true three-dimensional trajectories of knots of gas exhibiting definite mass motions. AUTHOR.

533. Sunspot Periods by the Fuhrich Method. B. Hanisch. *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 99–107, 1935.—For the investigation of the periodic character of relative sunspot numbers three intervals were chosen 1794–1841, 1835–1882 and 1880–1925, and from the yearly means four periodic components were extracted for each interval. The amplitude, phase, wave-length and phase-constant for each component in each interval is set out and discussed. The 11-year period appears to oscillate between 11·43 and 11·80 years, while an 8-year period is shown in each interval. The several periods are discussed and compared with former analyses. There is an apparent agreement between the 11- and 8-year sunspot periods and the brightness oscillations of certain planets, *e.g.*, Jupiter $11{\cdot}6 \pm 0{\cdot}4$ years and Uranus $8{\cdot}4 \pm 0{\cdot}3$ years. The use of rings in tree sections to extend the interval considered is discussed.
R. S. R.

534. Structure of Sunspots. T. G. Cowling. *Roy. Astron. Soc., M.N.* 96. *pp.* 15–20, *Nov.*, 1935.—There is a region below the photosphere of the sun in which the temperature gradient is much greater than in the surface layers. The temperature gradient in the matter immediately below a sunspot will only diverge seriously from the radiative value in this region. To produce a dark spot, matter in this region must be moving downward. AUTHOR.

535. Relative *f*-Values for Lines of Fe I from Electric-Furnace Absorption Spectra. R. B. King and A. S. King. *Mt. Wilson Observat. Contrib. No.* 528. *Astrophys. J.* 82. *pp.* 377–395, *Dec.*, 1935.—The total absorptions of lines of Fe I in furnace absorption spectra are measured at a temperature of 2100° C., and the relative intensities of the lines at that temperature are derived from the linear portion of the curve of growth of an absorption line where the total absorption $\propto Nf$. Variation of N, the number of atoms per c.c. in the furnace, allows the study of a wide range of intensities. The condition of thermal equilibrium existing in the furnace permits the application of the Boltzmann formula to the observed relative intensities and gives the relative *f*-values of the line. Only the relative *f*-values are obtained, since the absolute value of N is unknown. That the linear portion of the curve of growth affords a valid method of observation under these conditions is verified by comparison of the measured total absorptions of lines in five multiplets of Ti I with Harrison's measures of the relative intensities of these lines in the arc. The condition of thermal equilibrium in the furnace is checked by observing the change in the intensities of Fe lines arising from different levels when the furnace temperature is raised from 1800° C. to 2400° C. Relative *f*-values are given for 75 lines in 9 multiplets of Fe I of temperature classes

I and II in the region λλ 3650–4400. The average probable error is about 8 %. AUTHORS.

536. Photometry of Magnesium *b* Group in Solar Spectrum. E. Cherrington, Jr. *Lick Observat., Bull.* 477. *pp.* 161–170, 1935.—Spectrograms of the strong Mg triplet *b* (λλλ, 5167, 5173, 5184) region were taken with the horizontal Littrow solar spectrograph, together with the Fabry and Perot fixed separator type of interferometer, used for removing most of the continuous background so as to minimise the scattered light. After determining the distribution of monochromatic light, the effect of finite resolving power is got by estimating the true profile, and representing therefrom the observed. The square-root law is not held for the relative multiplet intensities in absorption, but departures from it increase with the photosphere's height above mean level of the lines, and this is perhaps due to self-reversal of strong lines through interlocking. The *b* lines show a sub-core as in a special case of Pannekoek's theory of the formation of absorption lines ; usually solar lines are either too strong or too weak for this sub-core. A. S. D. M.

537. Bolometer Measurement of Line Contours in the Infra-Red Solar Spectrum. A. Dahme. *Zeits. f. Astrophysik*, 11. *pp.* 93–97, *Dec.* 15, 1935.—From measurements of Abbott and Freeman's bolometer curves of the infra-red solar spectrum the total absorption of the Paschen H lines ($n' = 5, 6, 7, 8$; $n'' = 3$) is obtained, and hence the number of three-quantum H atoms ($n'' = 3$) per cm.^{2} of photosphere is calculated. The results agree well with those obtained photographically by Rosenthal. The distorting influence of the apparatus is also investigated. Similar measurements are made for the $4^2P \leftarrow 3^2D$ lines of Ca^+ at λλ 8662, 8542 and 8498, and the results compare satisfactorily with Mulders' and Unsöld's photographic results. The bolometer method therefore appears promising. W. J.

538. Energy Distribution in the Continuous Spectrum of the Sun. G. F. W. Mulders. *Zeits. f. Astrophysik*, 11. *pp.* 132–144, *Dec.* 15, 1935.—By counting through the revised Rowland Table and using the calibration curves of Rowland's scale of intensities in equivalent breadth [see Abstract 4518 (1935)], the total energy is determined which has disappeared from the continuous spectrum of the sun in the formation of the Fraunhofer lines, as a function of wave-length. The differences between Abbot's curve of the *mean* energy distribution in the solar spectrum, and the measurements of Plaskett in the continuous spectrum between the lines are shown to be wholly due to the Fraunhofer lines. By accounting for this absorption, the energy distribution in the continuous spectrum of the centre of the sun's disc between 3000 and 23,000 Å is obtained from the various measurements and is shown to differ notably from the black-body radiation : the " colour temperature " between 4100 and 9500 Å would be 7140^0, against 4850^0 between 3000 and 4000 Å. The coefficient of blanketing is found to be 0·083. From the energy distribution the absorption coefficient is calculated as a function of wave-length. AUTHOR.

See also Abstracts 493, 513.

GEOPHYSICS.

GEODESY.

See Abstract 436.

GEOPHYSICS, APPLIED.

539. Use of Hummel's Universal Curves of Apparent Resistivity. A. Belluigi. *Beitr. z. angew. Geophys.* 5. 3. *pp.* 296–302, 1935.—It is shown that methods of reducing the effect of many superposed layers to that of two layers can be extended to geological cases. The curves of Hummel are then tested and evaluated so that they can be applied to an actual region with an exactness depending only on the conditions of measurement and the difficulties of the region. W. A. R.

HYDROSPHERE, PHYSICS OF THE.

540. Annual Variation of Temperature of Ocean or Lake. T. Namekawa. *Kyoto Coll. Sci., Mem.* 18. *pp.* 239–245, *Sept.*, 1935. *In English.*—The usual assumption that eddy convection governed the annual variation of temperature leads to contradictory results when the usual form of eddy equation is used and transfer of heat from the upper to lower layers is considered. A new form of eddy diffusion equation is developed using either the monthly mean temperature or a daily value which can be adopted for this purpose and adding a new term for the upward flux of heat due to spontaneous mixing which occurs only in the cooling stage of the water. On the main terms good agreement is obtained between the theory and observations at 50 m. and 100 m. off the coast of Shionomisaki and a mean value can be obtained for the eddy diffusivity. R. S. R.

541. Thermal Convection in the Interior of the Earth. C. L. Pekeris. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 3. *pp.* 343–367, *Dec.*, 1935.—The general question of convection between two concentric spheres with higher temperature at the centre and the possibility of thermal convection in the interior of the earth over the few tens of km. for the crust to 2900 km. the core boundary are discussed. The shell is assumed to be a plastic fluid possessing a finite coefficient of viscosity and the circulation produced in it by a given zonal temperature perturbation is investigated. It is assumed that the crust is rigid and that the core cannot sustain any shearing stress and the distribution of velocities and stresses in the shell are found. Next the distortion of the crust due to the reaction of the convective substratum on it and to the thermal expansion caused by the assumed temperature perturbation is found. The gravity anomalies at the new geoid level are computed. Six cases of thermal convection in the earth are chosen to exhibit the effect of variations in the type of temperature perturbation the distribution of density and viscosity, and the thickness of the convective region. Finally, the energy transformations in the convective shell are discussed. R. S. R.

542. Secondary Circulation of Ocean Produced by Winds. H. Arakawa, S. Ooma and W. Nagaoka. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 408–422, *Oct.*, 1935.—This is a mathematical paper and its object is to examine the coast effect on ocean currents produced by winds. The

stresses due to the winds are assumed to be derivable from two functions Φ and Ar analogous to scalar and vector potentials. The currents due to a system of tangential stresses given by Φ are first discussed. With uniform and small depth of ocean and non-rotating earth the horizontal current at the surface is shown to be in the direction of the wind and proportional to the tangential stress. The current below flows in the reverse direction. The limits of the depth of the surface of separation are found and also the angle of inclination of the surface of the sea. It is pointed out that Ekman's formula for the latter gives only the upper limit. The ocean currents produced by the stresses given by Ar are then discussed. Again their direction is that of the wind, but here the elevation of the sea surface is zero. A. E. M. G.

543. Tides in a Channel. S. F. Grace. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 302–310, *Dec.*, 1935.—Previous work on tidal motion in a rotating channel was restricted to the case where depth was uniform throughout. In this case the variation in tidal elevation in a channel due to variation in the depth is examined, and inferences are drawn from the elevation at a coastal station to conditions at sea. Friction is neglected. The results have reference to those obtained for the Bay of Biscay [see Abstract 2919 (1935)], but it is considered that any attempt to obtain by that method too close an agreement between theory and observation for the coastal elevations might lead to abnormal deep-sea conditions and provides a justification for the method of procedure adopted with the Bay of Biscay. R. S. R.

544. Effect of Varying Depth on Stability of Stationary Oscillations in a Lake or Sea. S. Sakuraba. *Imp. Marine Obs., Kobe, Japan. Mem.* 6. *pp.* 63–65, *Dec.*, 1935. *In English.*—The condition for stable oscillation in a rectangular basin the bed of which is steeply inclined, the depth increasing linearly with distance from one side, is considered mathematically. C. A. S.

545. Seiches Due to a Submarine Bank (Bank Seiches). K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 1–8, *Dec.*, 1935. *In English.*—Formerly the theory of seiches dealt chiefly with the cases of land-locked basins and gulfs. In this case the theory of seiches is investigated for a submarine bank. The maximum oscillation occurs above the bank and subsides as the distance from it increases. The results are tabulated for the distribution of amplitude with distance from the bank for the 1st and 2nd modes of oscillation. A numerical example is given for the Syunpû Bank in the Japan Sea. [See following Abstract.] R. S. R.

546. Theory of Shelf Seiches. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 9–12, 1935. *In English.*—The theory of submarine seiches [see preceding Abstract] leads to the theory for the case of shelf seiches. A straight coast with a vertical wall is considered and only an additive condition is required in the earlier theory. The values of amplitude and distance are tabulated and shown graphically for the 1st and 2nd mode. R. S. R.

See also Abstract 444.

LAND, PHYSICS OF THE.

547. Temperature of Ground Surface. I. Tuboi. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 67–84, *Dec.*, 1935. *In English.*—From observations at Kobe it is shown that outflow of heat exceeds inflow at night, the reverse by day; the change occurs about 2 hr. before sunset,

and about 1 hr. after sunrise. In summer about twice as much heat is received as in winter, but the outflow in summer is so much greater that the net difference, *i.e.* resultant amount entering the soil, is much the same summer and winter. C. A. S.

548. Densities of Rocks Calculated from Chemical Analyses. R. A. Daly. *Nat. Acad. Sci., Proc.* 21. *pp.* 657–664, *Dec.*, 1935.—Analyses of fresh holocrystalline rocks were used, each, including H_2O being reduced to 100 %. The norm ("standard" mineral composition) was then calculated (or the norms of Washington's tables accepted). The percentage weight of each standard mineral was multiplied by its specific gravity and the sum of these products regarded as the "normative density" of the rock supposed anhydrous (*a*). This figure corrected for $+ H_2O$ gives a normative density (*b*), almost exactly equal to the actual density (*c*). Results for 25 species are given, the maximum divergence between (*b*) and (*c*) being 5·9 %, or considering only results based on an average of < 5 samples of the rock, 1·4, peridotites and rocks containing > 1 % H_2O give the worst results. Applications to magmatic differentiation, comparison of plutonic and corresponding extrusive rocks, and determination of porosity of rocks are described. C. A. S.

549. Effect of Discontinuities on the Pressure Distribution in a Loaded Soil. M. A. Biot. *Physics*, 6. *pp.* 367–375, *Dec.*, 1935.—The pressure distribution due to a concentrated load on a semi-infinite elastic body is given by the well-known Boussinesq solution for either the two-dimensional or three-dimensional case. The effect is investigated on such a pressure distribution, taken at the depth *h*, of the presence at that depth of a slippery rigid bed (case (*b*)); of a perfectly rough rigid bed (case (*c*)); and of a perfectly flexible but inextensible thin layer embedded in the material (case (*d*)). Both pressure distributions in the two and three-dimensional problems are calculated for each case. Several authors have already investigated case (*b*) and case (*c*) in two dimensions. Their results are in perfect agreement with those now given. AUTHOR.

See also Abstracts 582, 585, 586, 587.

METEOROLOGY.

***550. Temperature of Atmospheric Ozone. J. Devaux.** *Comptes Rendus*, 201. *pp.* 1500–1501, *Dec.* 30, 1935.—A continuation of previous work [see Abstract 1545 (1932)]. After describing the apparatus used, *viz.*, spectrograph, etc., and the method of observation adopted in the present investigation, the author proceeds to discuss his results. These were obtained at the observatory on the Pic du Midi (2860 m.) during all seasons with clear sky and low water vapour pressure. The most interesting region of the spectrum is that around 10μ as here ozone has a strong absorption band. Three conclusions regarding the temperature of the ozone layer are arrived at: (1) it is considerably below 0° C.; (2) it does not undergo large diurnal variation; (3) it has no very marked seasonal variation. The last result is regarded as only approximate. A. E. M. G.

551. Accumulation of Radon in Aerosol. O. Macek. *Gerlands Beitr. z. Geophysik.* 45. 4. *pp.* 361–376, 1935.—Experiments are described showing that the adsorption of Rn atoms within the Aliverti apparatus [see Abstract 2923 (1935)] amounts to 1–2 % of the Rn atoms. The error thus caused is therefore negligible for measurements with the normal amounts of Rn and nuclei as in the open air. Where these are greater, *e.g.*, in cellars, caves, etc., the error can be removed by warming (to $\nearrow$ 100°) and blowing the collecting electrodes immediately after collection. C. A. S.

552. Vorticity in the Atmosphere as a Weather Factor. S. Fujiwhara, K. Nakata, H. Sibahasi, M. Uda, S. Oka, A. Harasima and N. Watanabe. *Tokyo Univ., Faculty of Sci., J.* 3. *pp.* 65–106, *Aug.* 15, 1935. *In English.*—This discussion is divided into five sections. In Part I, vorticity having been defined, the vertical component ζ only is dealt with. The mean value of ζ over an element of area is $\zeta = (1/s)(udx + vdy)$ where u and v are the components of the wind in the x and y directions respectively. In the present case the components used are those of the gradient wind. In Part II a number of charts showing isovorticity lines for seven consecutive days are given. Comparisons are made between these lines and the ordinary isobars. As a result it is found that (1) the areas of positive and negative vorticity coincide approximately with those of cyclone and anticyclone ; (2) the positive and negative areas of vorticity travel with the cyclone and anticyclone ; (3) the distribution of vorticity is irregular in the region between a cyclone and an anticyclone. Similar investigations are described and discussed in Parts III and IV. In particular it is shown that the distributions of cloud and rainfall are found to resemble closely that of vorticity. In the concluding section the relation of vorticity to convergency in air is discussed. A. E. M. G.

553. Effect of Humidity in Hot-Wire Anemometry. G. B. Schubauer. *Bureau of Standards, J. of Research,* 15. *pp.* 575–578, *Dec.*, 1935.—The possibility of a humidity effect on the heat loss from a heated wire in an air stream has long been recognised, but only recently was the effect found experimentally by Paeschke [see Abstract 4103 (1935)]. The effect is to increase the heat loss at the higher humidities. The present paper describes an experiment conducted to verify the existence of the effect. The results show an increase of heat loss per degree rise in wire temperature of about 2 % for a change in the partial pressure of water vapour from 0·007 to 0·023, or a change in relative humidity from 25 to 70 % in the neighbourhood of 25° C. The effect may be explained by an effect of humidity on the thermal conductivity of air. AUTHOR.

554. Advective-Dynamical Theory of Atmospheric Pressure Oscillations and their Periodicity. H. Ertel. *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 227–236, 1935.—The differential equation for the spatial distribution of the pressure field is set out and this is integrated by means of spherical functions. The law of compensation of a disturbance is discussed and its orthotropic migration and thus the rate of propagation of cyclones and anticyclones is given. The deformation of the original pressure field by the development of advective-dynamical disturbances is treated and also the resultant migration cells. The permanent periodic spectrum of pressure is given and the methods of selection of periods. Finally a method is set out for the preliminary calculation of the atmospheric pressure field from the isobaric and isallobaric pressure fields. R. S. R.

555. Lunar Atmospheric Tide in the Azores. S. Chapman. *Roy. Meteorolog. Soc., J.* 62. *pp.* 41-45, *Jan.*, 1936.—This is a continuation of previous work [see Abstract 2927 (1935)] and deals with results obtained from two island stations in mid-Atlantic. From bi-hourly data of the barometric pressure over a period of 39 years at Ponta Delgada and of 26 years at Santa Cruz the second harmonic component of the lunar atmospheric tide has been determined for these stations. The mean results are $22 \sin(2t + 55°)$ and $18 \sin(2t + 58°)$ in microbars respectively, both amplitude and phase angle being low. High tide thus occurs 72 and 65 minutes respectively after lunar transit. An examination of the seasonal

results indicates that, as at most other stations, the tide is later near the December solstice than at other times. The harmonic coefficients for the first four components of the solar diurnal variation are also given. A. E. M. G.

556. Mean Annual Circulation over the British Isles. A. H. R. Goldie. *Roy. Meteorolog. Soc., J.* 62. *pp.* 81-98; *Disc.*, 98-102, *Jan.*, 1936.—The mean drift of the air in a year across a line joining two stations can be measured by the mean pressure gradient between these places. These values for Eskdalemuir-Lerwick are plotted giving the W. by N. drift. The graph shows a period of about 3·8 years separating the maxima. "The object of this note," says the author, "is not to discuss the reality of a periodicity, but rather to set out certain characteristics of the years affected and to indicate certain other relations with other meteorological factors and with terrestrial magnetism." Accordingly, when the years of maximum flow or H years are examined they are found to be years showing pressure above the normal while years of minimum flow, or L years, are years of pressure below the normal. When temperature, sunshine and rainfall are examined, the H years show temperature and sunshine values above those for the L years, while rainfall, on the other hand, is greater in the L years. The question of gales has also been investigated. The secular changes in the horizontal magnetic force as deduced from the observations of a number of European observatories is also discussed and comparison made with the variation in air flow. This discussion, in the author's opinion, may suggest the beginnings of a scheme of classification of weather types. A. E. M. G.

557. Configuration, Air Mass and Rainfall. R. M. Poulter. *Roy. Meteorolog. Soc., J.* 62. *pp.* 49-76; *Disc.*, 76-79, *Jan.*, 1936.—The following theory is developed by the author following a wide survey of existing literature on the subject. If a warm front sloping at 1 in 100 passes over land sloping up at 1 in 100, the rainfall will be approximately doubled, while a cold front sloping at 1 in 50 passes over the same land, the rainfall will increase nearly 50 %. Over such countries as the British Isles the ratio of rainfall on a slope n in 100 facing the prevailing wind to that on level ground at same height is $\{1 + n(W + C/2)\}$: 1, W and C being the proportions associated with warm and cold fronts respectively. If P be the normal increase with height above M.S.L. the increase on a slope facing the prevailing winds is $P\{1+n(W+C/2)\}$. This gives $R_h = R_o + P\{1+n(W+C/2\}$. Values of P, W and C are given for the British Isles. Thereafter leeward slopes are considered. The rate of increase per 100 feet varies from 0·4 in. on leeward slopes to 4 or 4½ in. on a windward slope of 4/100. A number of diagrams illustrate the paper. A. E. M. G.

558. Surface Resistance in Atmospheric Flow. R. C. Sutcliffe. *Roy. Meteorolog. Soc., J.* 62. *pp.* 3-12; *Disc.*, 12-14, *Jan.*, 1936.—Reference is made to Taylor's value of the coefficient of skin friction between the atmosphere and the earth's surface based on 97 pilot balloon ascents and amounting over Salisbury Plain to 0·0023 — 0·0032. An assumption made, now known to be in error, was that the coefficient of eddy viscosity was practically independent of height. The author explains why he considers that the conception of skin friction is in error and that surface form resistance is the important one. Over reasonably open country the surface resistance is related to the wind at 10 m. Computations are made from pilot balloon ascents of the magnitude of surface resistance, which is defined as the rate of transference of momentum from the air to the earth. This is illustrated by observations made at Upper Heyford and finally values are tabulated for three inland sites and the open sea which lead to

average values for the coefficient of surface friction amounting to 0·006 over land and 0·0004 for the open sea. R. S. R.

559. Saturation Measurements with Atmospheric Condensation Nuclei. C. Junge. *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 108–129, 1935.—The important supersaturated regions of 0–20 % of Aitken condensation nuclei with fog and cloud formation are investigated. The contents of a fog chamber are expanded by increasing steps and the number of drops formed is determined photographically. The condensation spectrum or distribution of nuclei is thus found for each supersaturated region. With a small gas flame the largest possible nuclei are produced, their ionic spectrum is measured, and their size found with an Israel ionic counter. Köhler's conception of the nuclei as salt drops, based on the calculated relation of the radius and supersaturation is confirmed. The growth of the nuclei with relative humidity, measured with the ionic counter, does not agree so well with theory. Nuclei emitted by glowing Nernst filaments show that, corresponding to the loss of water by the filament, they have a structure quite different from the hygroscopic and are probably gas flame ions from H_2SO_4. An explanation for the apparent contradiction between the Wigand and other observations shows that dust, etc., supply no condensation nuclei. R. S. R.

560. Diffusion Coefficients and Velocities of Fall in Air of Atmospheric Condensation Nuclei. J. J. Nolan and V. H. Guerrini. *Roy. Irish Acad., Proc.* 43*A*. 2. *pp.* 5–24, *Dec.*, 1935.—Methods for determining the diffusion coefficients and velocities of fall in air of atmospheric condensation nuclei are described. The values found for nuclei in Dublin air are $D = 18 \times 10^{-6}$ cm.²/sec., $V_g = 7{\cdot}5 \times 10^{-5}$ cm./sec. From these values a direct calculation gives for the mass of the nucleus the value $1{\cdot}68 \times 10^{-16}$ gm. By the application of Stokes' law, as empirically modified, the radius of the nucleus is found to be $2{\cdot}85 \times 10^{-6}$ cm. Samples taken from stored nuclei show a progressive increase in size and decrease in weight of the nucleus with time. Some determinations of D and V_g made on nuclei in country air are given. It is suggested that the relation found between the concentration of small ions and nuclei in the atmosphere can be explained by taking account of the fact that in nucleated air the size of the nuclei increases as their concentration diminishes. AUTHORS.

561. Correlations between Upper Winds and Meteorological Elements. R. Uyeda, Y. Oka and M. Terashima. *Tokyo Univ., Faculty of Sci., J.* 3. *pp.* 107–147, *Aug.* 15, 1935. *In English.*—The upper wind data used in this investigation were obtained from observations made at Tateno Observatory over a period of 10 years from 1923. The values refer to a height of 5000 m. The method of obtaining means for the day or the month is given in detail, and monthly means of total wind velocity and component velocities are tabulated. Corresponding tables give the values for pressure, temperature precipitation and cloud amount over the same region. Graphs are drawn from these tables and correlation coefficients calculated for pairs which appear to be correlated. The coefficients obtained are tabulated and the corresponding graphs reproduced. A second set of diagrams enables a clearer understanding of the distribution of the correlations in a year to be obtained. Further, a comparison is made between upper wind data obtained in Korea from 1930 onwards with the Tateno data. The wind velocity in Korea is smaller, the ratio being 2/3 in summer, 3/4 in winter. An Appendix deals with

the correlation in the monthly changes between the upper wind and ground temperature and also precipitation ; also between the upper wind and the solar constant. The results are shown graphically. A. E. M. G.

562. Atmospheric Circulation and Precipitation in the Near East. G. Bauer. *Gerlands Beitr. z. Geophys.* 45. 4. *pp.* 381–548, 1935.—A general review of the geographical distribution is given first. The observational material used include that from the Near East and also series from adjoining countries. The period 1895–1924 is used and all observations are as far as possible reduced to this period. From the wind observations, charts of flow are constructed, using frequency vectors, and pressure charts are also prepared for each month and season. The winter and summer monsoons and the spring and autumn transition periods are treated separately. For each the source of the air mass, its track and vertical depth are described and the period of the year to which they apply. The distribution of precipitation throughout the year and how it originates is described fully and illustrated by charts. A voluminous Bibliography is given. R. S. R.

563. Absorption and Emission of Heat by the Earth. R. Spitaler. *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 180–189, 1935.—Using Hann's isothermal charts for January, July, and the year calculation of the mean temperature t_φ for latitude ϕ from the mean monthly (S), and mean yearly (S_o) radiation leads to the relation $t_\varphi = M + cS$ where M and c are constants. The values of the constants are tabulated for each 10° of latitude but for any one place depend upon the distribution of land, the effects of atmospheric convection, cloudiness, changing sea temperatures, prevailing winds and sea currents. The degree of continentality (K) at any place is given by ($c\ S_o$–M). In a table are set out values of K and the other constants for 46 stations and two levels in the free air. In the free air K is smaller in the lower layers and greater in the upper layers than for land in their latitude (50° N). The constants used and also K are varying during the course of the year, but the variation is difficult to determine. [See following Abstract.] R. S. R.

564. Annual Change of Absorption and Emission of Heat or Degree of Continentality. R. Spitaler. *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 190–192, 1935.—From the mean values of $t = cS + M$ [see preceding Abstract] differences arise because of the winter cooling extending into spring and the summer heating into autumn. If this difference (B–R) be obtained and also (cS–M) one can get true values for the continentality (K). From 10 German stations mean values are obtained for K in each month, season and the year. It is shown that K increases from January to July and then decreases. Changes of S due to length of day and turbidity of the air alter K giving an increase in summer and a decrease in winter. Thus K becomes greater in continental and less in maritime zones. This is shown for Charbin and Ponta Delgada. Lines of equal continentality can thus be constructed over the globe. R. S. R.

***565. Brightness of the Sky. C. W. Allen.** *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 32–44, 1935. *In English.*—Apparatus is designed and used for measuring the intensity of the sky radiation within 3° of the sun and from other parts of the sky. The theory of sky brightness is reviewed, and the results of computations are tabulated giving the theoretical intensity of radiation from a dustless sky for several zenith distances of the sun, zenith distances and azimuths of the sky, and heights

of the ground above sea level. The theory is compared with observations. In general, the smallest measured sky intensities agree fairly well with the dustless sky theory, but for the sky within 3° of the sun the measured values are always at least three times as great as the values calculated for a pure atmosphere. AUTHOR.

566. Analysis of Partially Polarised Light from the Sky. E. Medi. *Accad. Lincei, Atti*, 22. *pp.* 331–334, *Oct.*, 1935.—Light from the sky is passed through two nicols which can be rotated together or separately and then falls on a photo-cell, which is joined either directly or through an amplifier to an electometer. The deflection due to the minimum intensity is found when, the angle between the planes of polarisation of the nicols being zero, the two are rotated together. They are then rotated through $\pi/2$ to give maximum intensity. The first nicol is fixed and the second rotated through an angle ζ, when the intensity equals the minimum obtained before. If P is the intensity of the polarised light and N that of the natural light of the sky, then $P/(P + N) = \sin^2 \zeta/(2 - \sin^2 \zeta)$ which gives the amount of polarised light reflected from the sky. H. M. B.

***567. Visibility Photometers for Measuring Atmospheric Transparency. G. M. Byram.** *J.O.S.A.* 25. *pp.* 388–392, *Dec.*, 1935.—Determinations of the transparency factor of air are made from measurements on haze brightness or on the intensity of light scattered and reflected by particles in the air. From the theory of the method it is shown that this is a direct measurement of the amount of light absorbed in a given distance rather than the amount transmitted. The methods of using the visibility photometer and also a visibility or haze meter in connection with the safe range of smoke columns are described. In a table the distance of photometric balance for different types of days is set out. R. S. R.

***568. Photoelectric Method of Measuring the Transparency of the Lower Atmosphere. G. M. Byram.** *J.O.S.A.* 25. *pp.* 393–395, *Dec.*, 1935.—Sunlight is reflected from a mirror upon two Weston photronic cells distant 8300 and 1900 ft. from it and from the ratio of the readings the transmission factor is obtained independent of the actual brightness of the sun, the centre of the sun being focused in turn on each cell. The theory of the method is given. The apparatus is calibrated on a clear day with a known transmission factor and sample observations are quoted. The visual distance, d, of an object for an individual with normal vision is connected with the optical density, k, by the equation, $d = (-1/k) \log 0{\cdot}02$. The quantity $0{\cdot}02$ is Fechner's constant but for some observers this may be as low as $0{\cdot}01$. R. S. R.

***569. Photometry of Twilight Colours: in particular of the Purple Light. P. Gruner.** *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 202–207, 1935.—By means of a special photoelectric photometer the intensity, I, of the light of the evening sky as a whole, and after passing through suitable filters so as to select the red, blue, bright red, dark red and green (with average wave-lengths 7000, 4800, 6500, 7300 and 5330 Å respectively) was measured. LogI and the ratios of the logI for pairs of different coloured lights are plotted against δ, the depth of the sun below the horizon, and I also against $1 + \cos^2\delta$ [see Abstract 1483 (1931)]. As δ increases light of greater wave-length at first ($\delta < 4°$) decreases relatively more slowly, but when δ is $> 4°$ more rapidly than light of less λ, thus accounting for the purple light. C. A. S.

570. Continuous Spectrum of the Night Sky and the Diffusion of Light in Space. J. Dufay. *Comptes Rendus*, 201. *pp.* 1323–1325, *Dec.* 23, 1935.—The bands and bright rays of the night sky are superimposed on a continuous spectrum interspersed with the dark Fraunhofer lines. In the region 5000 to 5800 Å the intense ray 5577 Å provides half as much illumination as the continuous spectrum. In the photographic region 3800 to 5000 Å the continuum provides at least 2/3 of the total illumination. Comparing direct photometric measurements with the results of star counts according to magnitude it is found that the stars can account for at the most 1/5 of the total brightness. The faint stars of solar type can account for only 1/3 of the intensity of the continuous spectrum. The continuum is thus due mainly to the diffusion of solar radiation and from knowledge of its degree of polarisation it is concluded that diffusion is caused either by large particles such as meteorites or by particles which are small in relation to light wave-lengths and occupy such a large volume that diffusion of stellar radiation becomes as important as that of solar radiation and diminishes the polarisation. The latter possibility is examined; it is pointed out that it is essential to consider successive diffusions and an equation is given which should permit the theory of galactic diffusion by absorbing layers to be more rigorously tested. [See also Abstract 518 (1936).] J. E. K.

571. Excitation of the Auroral Green Line by Metastable Nitrogen Molecules. J. Kaplan. *Phys. Rev.* 49. *pp.* 67–69, *Jan.* 1, 1936.—The excitation of the auroral green line in tubes which show the two new afterglow spectra of nitrogen is described. The conditions of excitation in the present experiments are compared with those in the night-sky and in the aurora borealis. It is proposed that in both of these phenomena the $^1S_0$ state of oxygen which is responsible for the green line is produced by collisions between oxygen atoms and metastable nitrogen molecules in the $A^3\Sigma$ state. Processes proposed by other authors by which oxygen atoms may be excited to the $^1S_0$ state in the night-sky and in auroræ are discussed. AUTHOR.

***572. Stereoscopic Micro-Anemometer. L. W. Pollak and E. Pelzl.** *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 142–151, 1935.—For the investigation of the fine structure of wind the very light and inexpensive type of swinging plate anemometer devised by Schmidt is used. For recording, a stereophotogrammetric method is employed with a kine-camera. A mirror or prism attachment in front of the objective produces on the film two stereoscopic half pictures which can be measured with a stereomicrometer. The method is investigated theoretically and its usefulness and exactness proved practically and a few of the results are given. R. S. R.

***573. Wigand Visibility Meter. H. Sebastian.** *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 152–179, 1935.—The procedure followed with this instrument is first described. Errors arising in the procedure can be attributed to (1) instrumental defects or differences, (2) the assumption of a linear relation between atmospheric turbidity and scattering, whereas theory indicates a logarithmic relation between absorption, scattering, and the intensity of the light, (3) necessity for the introduction of correction terms in the Wigand formula, and (4) the effects of illumination of the object and background, colour, size of the aperture, and physical and psychological differences of the observer. For these reasons it is concluded that the results obtained (1) cannot be extrapolated to distances

greater than those used, and (2) that they are not suitable for comparison of climatic conditions. R. S. R.

***574. Lag of Deep-Sea Reversing Thermometers. Z. Yasui.** *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 33–41, *Dec.*, 1935. *In English.*—As reversing thermometers are used to determine the temperature of sea water it is important to investigate the lag of such. For this purpose the author used 10 reversing thermometers placed in a metal tank filled with water. The method of observation is clearly described. The investigation gave a value of λ, the decay modulus, of nearly 1·53, in Grossmann's expression $(T - T_0) = (T_1 - T_0)e^{-\lambda t}$. This indicates that a sufficient time-interval from immersing the thermometers until a steady state is reached is therefore 6 minutes even when all possible conditions occurring in oceanographical observations throughout all seasons are considered. Tables and a graph illustrate the paper. A. E. M. G.

***575. Sulphuric Acid Hygrometer. A. Blackie.** *Journ. Sci. Instruments*, 13. *pp.* 6–9, *Jan.*, 1936.—A form of absorption hygrometer is described in which the vapour pressure of aqueous vapour in the air is directly determined by the change in the pressure of a constant volume of the air before and after absorption of the water vapour by concentrated sulphuric acid. Precautions required in its construction and use are described. Author.

***576. Measurement of Very Low Relative Humidities. A. Simons.** *Phys. Soc., Proc.* 48. *pp.* 135–144, *Jan.* 1, 1936.—Methods available for the measurement of relative humidities lying between 0·5 and 10 % are discussed. A dew-point apparatus for measuring dew points down to − 40° C. is described, also a hygrometer using wet and dry thermocouples. Calibration curves are given showing the relation between the depression of the wet-junction temperature and the relative humidity over the above range for air-temperatures between 10° C. and 90° C.

Author.

See also Abstracts 547, 719.

SEISMOLOGY.

577. Correlation of Deep-Focus Earthquakes with Lunar Hour Angle and Declination. H. T. Stetson. *Science*, 82. *pp.* 523–524, *Nov.* 29, 1935.—A curve representing the resultant of the north-south and east-west components of the horizontal lunar tidal force would resemble the earthquake frequency curve with striking similarity. The gravitational tidal forces are much too small to be a major cause of earthquakes, but may offer some new evidence for the hypothesis of trigger action. W. A. R.

578. Deep-Focus Earthquakes. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 3. *pp.* 310–343, *Dec.*, 1935.—Certain features of deep-focus earthquakes including the presence of reflections *p*P,*s*P, and *s*S, close to the epicentre, and of surface waves being smaller and thus the core reflections P_cP and S_cS being recognised, make it possible to obtain information not yet available for normal earthquakes. Times of S are well determined between 25° and 70° but are contradictory outside this range. They are further affected by an additive constant Z special to each earthquake and attributable to focal depth within the upper layers. The value of Z corresponding to any known absolute depth is not yet known. The method by which Z can be obtained is given. Five earthquakes are studied and the results for each are set out and discussed. R. S. R.

579. Theory of Microseisms. F. J. W. Whipple and A. W. Lee. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 3. *pp.* 287–297, *Dec.*, 1935. —The results obtained by Banerji [see Abstract 2940 (1935)] and his reference to the results obtained at Kew are discussed and the latter are set out in detail. It is shown that (1) confusion between true microseisms and other disturbances shown on seismograms is negligible, this being illustrated by records obtained during violent wind storms over the North Atlantic; (2) the type of microseismic movement depends more on the geological structure round the seismological station than on its distance from the ocean, and Banerji's arguments are invalid; (3) the mathematical theory of ocean waves is set out and extended to allow for the compressibility of water and this shows that (*a*) the only simple harmonic waves of permanent type are the ocean waves of the ordinary theory and waves of compression travelling obliquely through the water with the velocity of sound, and (*b*) no explanation of how microseisms are generated on the ocean floor is provided; and (4) no complete theory of microseisms is yet possible but progress may be made by realising that the action between air and water fluctuates, both the length and width of a train of sea waves being comparatively small. R. S. R.

580. Generation of Forced Oscillations on the Sea-Bed. E. F. Baxter and J. A. Archer. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 3. *pp.* 298–302, *Dec.*, 1935.—The results obtained by Banerji [see Abstract 3954 (1930)] relating to forced surface oscillations, caused over an elastic sea-bed arising from pressure variation in the sea due to the surface waves raised by the storm, is in error since it is the proportion of the change of load to the total load which produces these elastic waves. The corrected theory is set out. The results obtained are also compared with those for stationary waves on running water for which only a calculation of the statical yielding of an elastic solid due to a surface distribution of pressure is required. R. S. R.

581. Building Vibrations. N. R. Sparks. *Seismological Soc. of America, Bull.* 25. *pp.* 381–386, *Oct.*, 1935.—A brief account of the modes of vibration observed in buildings of various heights and ground-plans. R. F. A.

***582. Machine for Setting Structures and Ground into Forced Vibration. J. A. Blume.** *Seismological Soc. of America, Bull.* 25. *pp.* 361–379, *Oct.*, 1935.—The machine comprises a pair of oppositely-rotating balance-weights geared together and driven by an electric motor through a V-belt, which is disconnected at the highest frequency which it is desired to produce, and vibration records are made as the weights slow down. The frame of the machine is of duralumin and is connected to the structure to be vibrated, when horizontal vibrations are required, by baulks of timber. Curves are given showing the resonance frequencies for two dams, a bridge, a steep building-site, an area of dredger-filled ground and various buildings. R. F. A.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

583. Terrestrial Electric Field, Atmospheric Ionisation and Vertical Current. A. Dauvillier. *J. de Physique et le Radium*, 7. *pp.* 40–48, *Jan.*, 1936.—The increased conductivity in summer is attributed to the high content of Ra ($10 \cdot 6 \times 10^{-12}$ gm./gm.) of the gneiss on which the station is built, which is then not covered with snow. [See Abstract 4932 (1935).] C. A. S.

RADIOACTIVITY.

584. Properties of Radioactive Series. E. Lopoukhin. *Comptes Rendus*, 201. *pp.* 1361–1363, *Dec.* 23, 1935.—The proposals of F. Perrin [see Abstract 3315 (1932)] for the constitution of the lighter elements are extended to the heavier and on their basis certain regularities in the manner in which radioactive disintegration occurs in the elements naturally subject thereto are traced. C. A. S.

585. Yield of Emanation from Radium-Bearing Rocks to Flowing Water. H. Mache and G. Markstein. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 7–8. *pp.* 489–492, 1935.—The paper describes experiments carried out to test how the quantity of emanation given up by a solid radioactive material to flowing water depends on the concentration of emanation in the water, the temperature of the water and the grain size of the material. W. E. P.

586. Thorium Content of Rocks. W. D. Urry. *J. Chem. Phys.* 4. *pp.* 34–39, *Jan.*, 1936.—A new method for the determination of thorium in quantities of the order of 10^{-5} to 10^{-6} gm. is employed to complete the data necessary for the calculation of the age of geological material. The α-particle activity of thoron in a streaming gas is measured with a counter, a procedure which is shown to be superior to the usual ionisation measurements on the thoron deposit. Simultaneously, the Pa/Ra ratio in common rocks can be determined. [See following Abstract.] AUTHOR.

587. Radium Content of Rocks. W. D. Urry. *J. Chem. Phys.* 4. *pp.* 40–48, *Jan.*, 1936.—The determination of the age of common rocks by the "helium method" necessitates accurate measurements of the radium content. The method of compensating the background by the use of two opposed ionisation chambers is applied to radium determinations and the apparatus has an observational limit of $5{\cdot}5 \times 10^{-14} \times n^{-\frac{1}{2}}$ gm. radium for n hourly readings. With the Th content determined as above [see preceding Abstract] results for a suite of rocks from a single horizon and the present status of a geological time scale are given. AUTHOR.

***588. Radioactivity of the Atmosphere. G. Aliverti.** *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 223–226, 1935. *In Italian.*—The results obtained by the author's apparatus have to be corrected by factors 1·10 and 1·17 for d.c. and a.c. respectively. This agrees for d.c. with the work of Illing and Malek using a similar apparatus but their correcting factor for a.c. is 1·99. To test the accuracy, the author uses two consecutive identical pieces of apparatus and comes to the conclusion that (except for radon) there are no radioactive atoms in the atmosphere. He points out the sources of error in Illing and Malek's apparatus and concludes that his own gives a quick and sufficiently accurate measurement of the radon content of the air. H. M. B.

589. Vaporisation of Po, RaD and RaE. Margarete Hoffer. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 7–8. *pp.* 393–396, 1935.—The paper describes investigations of the vaporisation of Po, RaD and RaE in a vacuum. Curves are given showing the variation of the quantity of vaporised material with temperature. Po vaporises at a lower temperature than RaE and this vaporises at a lower temperature than RaD. The

temperature at which vaporisation takes place is less for fresh than for old preparations. [See following Abstract.] W. E. P.

590. Vaporisation of Po in Oxygen and Nitrogen. Elisabeth Rona and Margarete Hoffer. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 7–8. *pp.* 397–402, 1935.—An apparatus for the preparation, evaporation and measurement of Po in a gas-filled enclosure is described. It is found that Po vaporises at a lower temperature in an atmosphere of N_2 than in O_2. [See preceding Abstract.] W. E. P.

591. Distribution of ThC″ in Solutions of Thallium Salts. J. Zirkler. *Zeits. f. Physik*, 98. 1–2. *pp.* 75–76, *Nov.* 30, 1935.—When the Tl isotope ThC″ is dissolved in a solution containing equal amounts of $Tl^{\cdot}$ and $Tl^{\cdot\cdot\cdot}$ ions, and the $Tl^{\cdot\cdot\cdot}$ is precipitated by NH_3 in one portion, and $Tl^{\cdot}$ in another by HCl, with the $Tl^{\cdot\cdot\cdot}$ about 30 % of the total γ-activity appears, and with the $Tl^{\cdot}$ about 70 %. The relative percentages of the isotopes ^{203}Tl and ^{204}Tl being 29·6 and 70·4 it appears that the change in valency leads to a separation of the isotopes, the heavier isotope having a greater affinity for the monovalent ion. C. A. S.

592. Existence of an Unknown Natural α-Particle Emitter. J. Schintlmeister. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 7–8. *pp.* 475–487, 1935.—A review of investigations which lead to the view that an unknown natural α-particle emitter exists, shows that the α-particles in question are of range 2·1 cm. and that the unknown emitter occurs always in preparations of Sm. The author's experiments show that Ga, Ge, In, Tl, Se and P are inactive. From consideration of available data, the author expresses the view that Tm most probably contains the active substance. W. E. P.

593. Collisions of α-Particles with Neon Nuclei. W. W. Eaton. *Phys. Rev.* 48. *pp.* 921–928, *Dec.* 15, 1935.—The tracks of more than 700,000 α-particles from a source of Th active deposit are photographed in a Wilson chamber filled with a mixture of approximately 85 % Ne, 10 % air, and 5 % H_2. The collisions with nuclei are studied by replacing the film in the camera and projecting; convenient methods for doing this are described. A range-velocity curve for Ne recoil atoms is constructed by plotting the measured ranges against the calculated velocities for 85 forks. No interactions are observed which give any evidence of the disintegrations of nuclei, with the emission of protons or neutrons. From a particular study of six elastic, coplanar collisions in which high energies have been transferred to the recoil atoms, it is concluded that the probability of disintegrating Ne^{20} with α-particles of less than 6-cm. range (in air) is small; from this a lower limit for the mass of Na^{23} is calculated. The methods of measurement and calculation have been thoroughly tested by applying them to collisions with other nuclei, three with H_2, five with "air," one with He, and one with D_2. AUTHOR.

594. Ortho-Para Hydrogen Conversion by α-Particles. P. C. Capron. *Ann. Soc. Sci. de Bruxelles*, 55. *pp.* 222–236, *Dec.* 27, 1935.—The velocity of conversion of para-H at the ordinary temperature under the action of α-particles in presence of Hg vapour (which seems to retard the conversion) is proportional to the amounts of Rn and of para-H present. The reaction is actually effected by atomic H, which is produced by the α-particles at the rate of 1–2 atoms per pair of ions. The destruction of atomic H is a monomolecular reaction [see Abstract 1774 (1935)]. The ratio M/I is proportional to the concentration of para-H, but independent of intensity of irradiation. At the temperature of liquid air no formation of para-H is observed. C. A. S.

595. Theory of β-Disintegration. H. Yukawa and S. Sakata. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 467–479, *Nov.*, 1935. *In English.*—According to the theory of β-disintegration, the occurrence of the following phenomenon is expected. If the difference ΔW of proper energies of two isobares with the atomic numbers Z and Z−1 respectively is larger than $-mc^2+\mu c^2$, where m and μ are the masses of the electron and the neutrino respectively, the isobare Z will change into the isobare Z−1 by absorbing one of the orbital electrons. The probability of such a process is calculated, when the electron to be absorbed is initially in one of the K states and its bearing on the problems of the neutrino mass and the nuclear spin is discussed. The importance of this process relative to the ordinary disintegration process by positron emission is considered for ΔW larger than $mc^2+\mu c^2$. AUTHORS.

596. Scattering of Fast β-Particles by Nitrogen Nuclei. F. C. Champion. *Roy. Soc., Proc.* 153*A*. *pp.* 353–358, *Jan.* 1, 1936.—Using an automatic expansion chamber, the scattering of fast β-particles by nitrogen nuclei is examined between 20° and 180°. The results are in good agreement with the formula deduced by Mott on the basis of wave mechanics and justify the neglect of radiation losses in deducing the scattering law. AUTHOR.

597. Absorption Method for Determining Limit of Continuous β-Ray Spectrum of RaE. (Miss) A. Baschwitz. *J. de Physique et le Radium*, 7. *pp.* 37–39, *Jan.*, 1936.—RaD (in equilibrium with RaE and Po) was placed at varying distances below the ionisation chamber with or without screens of Al or bakelite between. Log (intensity of ionisation) was plotted against gm./cm.^{2} of total matter passed through. The curve consists of two straight lines joined by a curved portion, the first steep, due to β-rays, the second more horizontal, to γ-rays. The intersection of the two lines produced gives the path of the β-rays. This path is independent of canalisation with a Pb tube, and of intensity of the source, but varies with the distance between source and ionisation chamber, the variation being greater with an Al than with a bakelite screen. This is attributed to scattering, which is greater the higher the atomic number of the scatterer. C. A. S.

598. γ-Radiation Emitted in the Disintegration of $^9_4$Be by α-Rays. S. Franchetti. *N. Cimento*, 12. *pp.* 516–520, *Aug.-Sept.-Oct.*, 1935.—The γ-radiation from Be excited by α-particles from Po is studied, and the results obtained are compared with those relative to the emission of neutrons. Measurements of the absorption are made. The effect of bombarding the Be with α-particles of differing range is observed, and the results indicate that there is not a notable difference of coefficients of absorption between the γ-radiation emitted when Be is disintegrated with particles of 3·9 cm. penetration, and that of 1·5 cm. penetration in air for which the penetration of the nucleus of Be comes through resonance. This fact and the similarity which was found between the excitation curves of neutrons and of γ-rays supports the hypothesis that the γ-rays are emitted from the $^{12}_6$C formed in the reaction $^9_4\mathrm{Be}+{}^4_2\mathrm{He}\rightarrow{}^{12}_6\mathrm{C}+{}^1_0n$. J. J. S.

599. Rayleigh Scattering of Hard Radiation by Heavy Atoms. W. Franz. *Zeits. f. Physik*, 98. 5–6. *pp.* 314–320, *Dec.* 23, 1935.—It is here shown that the Rayleigh scattering even for the hardest γ-rays cannot be altogether neglected. The total coherent scattering of the

γ-radiation from ThC″ ($\lambda = 4{\cdot}7$ X–U) by lead is found to be about 1 % of the Klein-Nishina scattering. [See also Abstract 3911 (1935)]. A. W.

600. Internal Conversion of γ-Rays in the L-Shell. E. Stahel. *Helv. Phys. Acta*, 8. 8. *pp.* 651–664, 1935.—By measurements of the ionisation current produced in air by the L-radiation of RaD and of the number of α-particles emitted by the Po which had accumulated in the RaD samples since the time of preparation, the author finds that $25{\cdot}1$ % of the disintegrating RaD atoms emit L-quanta. According to Lay [see Abstract 5093 (1934)] the fluorescent yield for this L-radiation amounts to 42 %, so that 60 % of the disintegrating atoms have excited L-levels. As only $3{\cdot}5$ % of the primary γ-ray quanta leave the atom, the internal conversion coefficient for the L-level is $17{\cdot}1$, while the theoretical calculations of Fisk [see Abstract 1087 (1934)] for dipole and quadripole radiation yield values $1{\cdot}8$ and $2{\cdot}9$ respectively. The possible reasons for the discrepancy are discussed. W. E. P.

601. Theory of Internal Pair Production. H. Yukawa and S. Sakata. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 397–407, *Oct.*, 1935. *In English.*—The probability of internal pair production by radiationless transition of the radioactive nucleus is calculated and its ratio to the probability of emission of electrons from K levels by the same nuclear transition is compared with experiment in the case of RaC′. [See Abstract 1096 (1935).] Authors.

602. Production of Electron Pairs. J. C. Jaeger and H. R. Hulme. *Roy. Soc., Proc.* 153*A*. *pp.* 443–447, *Jan.* 1, 1936.—A method is given for finding the number of pairs created by a γ-ray traversing matter. The use of the Born approximation is avoided by using the exact wave functions for an electron in the presence of a heavy nucleus, but it is not possible to obtain closed formulæ for the absorption. The results obtained for γ-rays of energies $3mc^2$ and $5{\cdot}2mc^2$ give an absorption coefficient greater than that found by the Born approximation method. The present method also gives the energy distribution of the positrons, which shows the same characteristics as the experimental distribution found for the positrons created by Th C″ γ-rays in thin plates of lead. [See Abstract 1096 (1935).] Authors.

See also Abstracts **366, 367, 373, 551, 731, 903.**

RADIATION.

ABSORPTION AND TRANSMISSION.

***603. Photoelectric Opacimeter. P. Meunier.** *Comptes Rendus*, 201. *pp.* 1371–1373, *Dec.* 23, 1935.—The instrument described is for measuring opacities of coloured or turbid solutions ; it employs two rectifier photo-cells and a calibrated optical wedge, upon which the accuracy of the method depends. The light source is operated from the mains, as the system is such that fluctuations in the supply do not introduce errors. Measurements are reproducible to 0·5 %. D. H. F.

See also Abstract 384.

COLORIMETRY.

604. Colours of Distant Objects, and the Visual Range of Coloured Objects. W. E. K. Middleton. *Roy. Soc. Canada, Trans.* 29. *Sect. III. pp.* 127–154, *May*, 1935.—On the basis of the C.I.E. (1931) colour metric, expressions are developed for the colour coordinates and apparent brightness of black, white, grey, and coloured objects seen at any distance through an obscuring atmosphere. A comparison of the numerical results with the values of the saturation limen obtained by Jones and Lowry [see Abstract 2563 (1926)] leads to the conclusion that all objects become sensibly grey at distances somewhat less than the visual range. A study of the way in which the apparent brightness increases with distance shows that the visual range of an object of any colour is very nearly identical with that of a grey object of the same brightness factor ; thus there is no need for a special theory of the visual range of coloured objects.

AUTHOR.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

605. Magnetic Birefringence in Solutions of Organic Substances, Part I. S. W. Chinchalkar. *Indian Acad. Sci., Proc.* 2*A. pp.* 525–531, *Nov.*, 1935.—A number of aromatic hydrocarbons containing two or more benzene rings are studied for their magnetic birefringence in solution in suitable solvents. For diphenyl and most of its simple derivatives the molecular magnetic birefringence is nearly 4 times, for *m*-diphenylbenzene containing 3 benzene rings, it is 9 times, and for triphenyl benzene nearly 14 ($\sim 4^2$) times, that of benzene, suggesting that the benzene rings in these molecules are, to a first approximation, either coplanar or parallel to one another. When the benzene rings are " condensed," the magnetic and optical anisotropies are found to be much higher than when they are separate. AUTHOR.

606. Magnetic Rotatory Dispersion of Water. I. T. Pierce and R. W. Roberts. *Phil. Mag.* 21. *pp.* 164–176, *Jan.*, 1936.—The magnetic rotation of water for 11 lines in the Hg spectrum between 5780 and 2483 Å is determined photographically. Assuming Rodger and Watson's value for the Verdet constant (ρ) of water at 22° C, its dispersion is represented by $\rho = \{0{\cdot}001768+0{\cdot}0038723/[1-(0{\cdot}1311/\lambda)^2]^2\}/n\lambda^2$ with very high accuracy. This formula agrees with Ingersoll's

measurements in the infra-red, but the constants differ slightly from those obtained by Bruhat and Guinier. Previous dispersion formulæ are summarised. C. B. A.

607. Extinction of Mesomorphic Fluids in Magnetic Fields. Y. Björnståhl. *Zeits. f. phys. Chem.* 175. *Abt.A.* 1–2. *pp.* 17–37, 1935.—The alteration of the light extinction of some mesomorphic nematic fluids in a magnetic field is measured, melts of *p*-azoxyanisol, *p*-azophenetol and *p*-azoxyanisolphenol being investigated. The result already recorded by the author that the extinction is not uniquely determined by the temperature, and that fluctuations of the measurements are due to 'streaking', are compared with measurements in a transverse magnetic field. If the fluctuations are allowed for, the extinction is unaltered in a transverse magnetic field. Dichroism is not present in a magnetic field. Depolarisation is changed. In a longitudinal field the extinction decreases with the field strength to a 'saturation' value. The influence of walls, wave-length and temperature are discussed. The various extinction theories are considered in the light of the results. It is difficult to reconcile the results with the 'swarm' theory. J. E.

See also Abstract 876.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

608. Fluorescence of Ruby, Sapphire and Emerald. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 2*A. pp.* 459–465, *Nov.*, 1935.—The photo-luminescence of natural crystals of ruby, sapphire and emerald (beryl) is studied at room-temperature with a Fuess spectrograph of high light-gathering power. The ruby yields a number of new bands which have not hitherto been obtained. The spectrum of sapphire corresponds closely to that of ruby, but with slight differences. The spectrum of emerald consists of two sharp lines at 6806 and 6835 accompanied by other diffuse bands and is compared with that of ruby. The fluorescence in sapphire and emerald is also discussed with respect to the origin of luminescence in them. Photographs of the spectra illustrate the paper. Author.

609. Fluorescence of Porphyrins. A. Stern and H. Molvig. *Zeits. f. phys. Chem.* 175. *Abt.A.* 1–2. *pp.* 38–62, 1935.—The fluorescence of some porphyrins in dioxan is investigated and compared with absorption. The effect of substitutions—starting from ätioporphyrin—shows certain regularities which are in some part repeated in absorption. Thus the position of the maxima in both cases is very similar in normal porphyrins in spite of quite different substitutions. The principal lines and band I of the fluorescence occupy approximately the same place as the red band and band I*a* of the corresponding absorption spectrum. But a number of porphyrins, as the γ substitutions, show deviation from this rule—as do those containing simultaneously unsaturated and carbonyl groups. Positional isomers are indistinguishable as regards fluorescence, though those isomers which have large differences in side chains show differences in fluorescence spectra. The effect of different substitutions in dihydroporphyrins and the fluorescence of derivatives of chlorophyll *a* and *b* are investigated with results indicating regularities from which deductions as to structure can be made. Certain solid derivatives are also investigated. J. E.

610. Fluorescence of Pure Substances. E. Canals, P. Peyrot and R. Noël. *Comptes Rendus*, 201. *pp.* 1485–1489, *Dec.* 30, 1935.—The same method as previously described [see Abstract 4201 (1935)] for examining the fluorescence of organic acids is here used for alcohols. The depolarisation factors found increased steadily with n for alcohols containing C, C^2, C^3, C^4, as against the alternative found in the corresponding acids. Iso-propyl, iso-butyl and iso-amyl alcohols have depolarising factors which increase in order, but the anisotropy decreases on passing from normal alcohols to isomers. Benzyl alcohol has a factor which is abnormally high and may be associated with the double linkages in the aromatic ring. Comparing the factors for benzyl alcohol and toluene it is found that the alcoholic substitution increased the anisotropy. All the alcohols studied are fluorescent though with the exception of benzyl alcohol it is feeble and always weaker than the corresponding acid. J. E.

611. Resonance Fluorescence of Benzene. Part II. G. R. Cuthbertson and G. B. Kistiakowsky. *J. Chem. Phys.* 4. *pp.* 9–15, *Jan.*, 1936.—Further study of resonance radiation of benzene with new technique and amplified interpretation [see Abstract 4957 (1932)]. The new assignment shows that only changes of quantum number of one vibration of unexcited molecule ($\nu_1 = 990\text{cm}^{-1}$.) are unrestricted in fluorescence under exictation by λ2536 of Hg. For other vibrations the quantum number change is not greater than one (or two when required by selection rules). This interpretation becomes clear for most of these groups on the new plates. Five frequencies, besides ν, are tentatively identified, viz., 432, 791, 1542, 2557 and 3174 cm. $^{-1}$. The fluorescence of hexadeuterobenzene is also studied and frequencies of 944 ($\Delta\nu$ unrestricted) and 2460 found. The quenching of benzene fluorescence is studied with 5 different gases. The quenching action is quite unspecific, and appears to increase as the kinetic cross-section of the foreign gas increases. Some new high pressure bands are observed which support V. Henri's analysis of the absorption spectra as consisting of two close electronic levels. J. E.

612. Fluorescence Method for Determining Small Ozone Concentrations. M. Konstantinowa-Schlesinger. *Acta Physicochimica*, 3. 4. *pp.* 435–450, 1935. *In German.*—The gas mixture is sent through a solution of dihydroacridin and the chemiluminescence caused by oxidation is measured photometrically. J. E.

613. Optimum Concentrations of Active Foreign Materials in Crystal Phosphors. G. Schumann. *Zeits. f. Physik.* 98. 3–4. *pp.* 252–261, *Dec.* 14, 1935.—A critical discussion is presented of the properties of activated crystal phosphors in which according to theory the atoms of activating foreign materials are assumed to be distributed in structural faults or holes in the crystal lattice. It is shown that the hitherto determined optimum concentration of foreign material has been insufficiently defined and the various factors which should be taken into account in making new determinations are examined. J. E. K.

614. Heterogeneities in Crystals and Their Phosphorescence. M. Curie. *Comptes Rendus*, 201. *pp.* 1352–1353, *Dec.* 23, 1935.—Recent researches on dark- and photo-conductivity of crystals has shown the importance of nuclei of heterogeneity in regular lattices. Phosphorescence is observed in precisely those crystals which are electronic semiconductors at ordinary temperatures. Phosphorescence of long duration

is associated with impurities and its excitation is accompanied by ionisation. It appears that the electrons associated with phosphorescence become momentarily attached to the centres of heterogeneity created by the impurity. It is supposed that an electron detached from a luminescent centre suffers collisions of the second kind with excited atoms of the main lattice and then becomes attached firmly to the nuclei of heterogeneity. This supposition obtains support from the common nature of *d* excitation bands in a common lattice with varying impurities. The author has established the fact that there are no *d* bands of absorption unless impurities are present. J. E.

615. Thermoluminescence and Chemiluminescence. H. Steinmetz and M. Alt. *Zeits. f. Krist.* 92. 5-6. *pp.* 363–371, *Dec.*, 1935.—It has been hitherto considered that thermoluminescence of minerals is due to traces of radioactive substances. The thermoluminescence represents part of the energy released when the activated centres return to a normal lattice condition. Obviously thermoluminescence of precipitated substances cannot be so explained since there is no time for the excited centres to be formed. Such substances must be chemiluminescent. Experiments are described which show that the thermoluminescence of salts such as $BaCl_2$ is probably due to traces of organic substances and that the presence of CO_2 and O_2 are necessary. Similar experiments *in vacuo* and air with minerals show that part of the thermoluminescence is often chemiluminescence. J. E.

616. Thermoluminescence of Felspars. S. Iimori and E. Iwase. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 610. *pp.* 147–151, *Dec.*, 1935. *In German.*—By the use of 12 times renewed samples of felspars excited to thermoluminescence by X-rays (50 hr. exposure) and the use of activated plates and a highly light-gathering Kipp-Zonen spectrograph, the authors have been able to get spectrograms of the thermoluminescence which could be photometered. Five photometer curves and three spectrograms are reproduced. J. E.

See also Abstracts 627, 671.

INTERFERENCE. DIFFRACTION AND SCATTERING.

617. Intensity Distribution in Interference Fringes. J. Roig. *Comptes Rendus*, 201. *pp.* 1346–1348, *Dec.* 23, 1935.—Fine structure determinations made by studying fringes formed at infinity may be at fault if the monochromator slit is not uniformly illuminated, or if the sensitivity of the plate be not uniform. A photographic method is described, employing a Glazebrook prism, by means of which both the errors mentioned may be eliminated. A. H.

618. Dust Effect in Longitudinal Light Scattering. L. Šplait. *Zeits. f. Physik*, 98. 5–6. *pp.* 396–398, *Dec.* 23, 1935.—The author criticises a recent publication by S. M. Mitra [see Abstract 4204 (1935)], and states that this effect only occurs in the u.v. region of the spectrum for compounds of high molecular weight. In this region the Tyndall effect completely disappears. Precautions to be taken for successful experiments are discussed, and it is pointed out that liquids should be optically empty, *i.e.*, homogeneous in the ultramicroscope, whereas Mitra employed liquids containing microscopic particles. Other defects in Mitra's technique are pointed out in some detail. H. H. Ho.

***619. Depolarisation of Molecularly-Scattered Light. H. Volkmann.** *Ann. d. Physik*, 24. 5. *pp.* 457–484, *Nov.*, 1935.—New apparatus

is described, with which the depolarisations have been measured for CH_4, H_2, CO_2, and N_2O, of the light scattered by the molecules (Rayleigh scattering). The results of previous workers are compared, and the great diversity of the results obtained is stressed. An analysis is made of the errors to which such apparatus is subject, and the chief source of error is thought to be due to a property of the Wollaston prism frequently employed. It is shown that if the beam of light striking the Wollaston is not of uniform intensity across its cross-section, the Rayleigh $\tan^2 \alpha$ law will not be fulfilled, but the difficulty can be got over by replacing $\tan^2 \alpha$ with $\tan \alpha_1 \times \tan \alpha_2$, where α_2 has been obtained after rotating the Wollaston through 180° from the position in which α_1 was found. For CH_4 is found ρ (depolarisation) = O, whereas earlier workers obtained 0·015 and 0·0112. This removes the objection against the tetrahedral symmetry of CH_4. For CO_2 is found $0{\cdot}0724 \pm 0{\cdot}003$; for H_2 $0{\cdot}009 \pm 0{\cdot}001$, and for N_2O, $0{\cdot}102 \pm 0{\cdot}004$. A. C. M.

620. Selective Scattering of Light in Mercury Vapour. G. Landsberg and L. Mandelstam. *Phys. Zeits. d. Sowjetunion*, 8. 4. *pp.* 378–400, 1935. *In German.*—The selective scattering of the line 2558 Å in mercury vapour is investigated, and a method is given which allows the separation of the scattering into atomic and molecular scattering, employing the extinction brought about by hydrogen. The intensity of the atomic scattering is measured and found to agree with that theoretically expected. The dependence of the scattering intensity on the vapour density is examined, and it is found to be proportional to the vapour-density. The intensity ratios of the lines 2558 Å and 2502 Å show the selective nature of the phenomenon. The molecular scattering is only weakly polarised, while the atomic scattering is almost completely polarised. The dependence of the molecularly scattered light-intensity on the pressure of the hydrogen added can be expressed by the formula of Stern and Volmer. The extinguishing effect of nitrogen is small. A. C. M.

621. Artificial Crystal Lattice for Interference with Light Waves. W. Kramer. *Zeits. f. techn. Physik*, 16. 11. *pp.* 447–449, 1935. *Phys. Zeits.* 36. *pp.* 841–843, *Dec.* 1, 1935.—A method, based on the production of standing waves, is described for making an artificial lattice which will diffract light waves in the same way as a crystal lattice diffracts X-rays. The conditions for the preparation of this lattice are discussed and its properties are described. J. T.

***622. Anomalous Diffraction Gratings. R. W. Wood.** *Phys. Rev.* 48. *pp.* 928–936, *Dec.* 15, 1935.—This is a continuation of work done in 1907 and 1912 on gratings showing narrow bright and dark bands in a continuous spectrum. A Cr plated echelette ruled on Cu with 7200 lines per in., and a 15,000 lines per in. ruling on Al on glass have been used. The missing energy has been traced to the central image, and the dark bands explained by a sort of destructive interference along the plane of the grating. The spectra from the Al grating are completely plane polarised, the width of the scratches being considerably less than a wave-length of light. The dynamical action of the gratings is discussed. F. S.

***623. Theory of the Multiple Diffraction Grating. N. Hilberry.** *J.O.S.A.* 26. *pp.* 1–11, *Jan.*, 1936.—The theory of a multiple diffraction grating is presented. It is shown that the resolving power is that of a simple grating of equivalent ruled aperture; the intensity, that of a simple grating of an equal number of ruled apertures; and the dispersion

and resulting distribution of intensity with order, that of one of the elementary gratings of which it is composed. The relative intensities and the distribution of the secondary maxima arising due to the periodicity of spacing of elementary gratings are discussed. The large spectral range, the relatively high intensity and the requirement of little or no preliminary resolution are presented as advantages over interference spectroscopes of equivalent resolving power. The further advantage is presented that the time required for ruling such a grating is so reduced that gratings of two, three or more times the present effective aperture are made readily possible in the same ruling time. AUTHOR.

*624. **Diffraction Gratings.** F. F. P. Bisacre. *Phys. Soc., Proc.* 48. *pp.* 184–188, *Jan.* 1, 1936.—Used under the best conditions for brightness a grating should show little polarising effect. The reason for this is that the Huygens-Kirchhoff integrals for the electric and magnetic vectors have different cosine factors which have the same value only in the case of ordinary reflection. An extension of these integrals bringing in a second approximation is given. This approximation becomes important if either the radius of curvature is comparable to the wave-length of the light, or if the angle of incidence is very nearly 90°, as it may be in soft X-ray experiments. A new curve for the effect of slit-width upon the resolving-power of a spectroscope is given. This is compared with Schuster's curve, based on the assumption that the slit is filled with incoherent light, whilst the present curve assumes coherent light. The two curves are probably limiting cases. A new method of ruling concave gratings, radial ruling, is suggested. In this the diamond is given a uniform chordal displacement from line to line, as in the current method, but during each displacement it is rotated about an axis parallel to the ruled lines and passing through the centre of curvature of the grating face. A. H.

See also Abstracts 599, 724, 785, 786, 906.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

625. Photochemical Oxidation of Carbon Monoxide in the Schumann Region. B. Popov. *Acta Physicochimica*, 3. 2–3. *pp.* 223–244, 1935. *In English.*—The oxidation of CO by O produced by the optical dissociation of O_2 molecules in the region $\lambda < 1750$ Å, is manometrically measured at a pressure of the gas mixture of about 0·1 mm. Hg and at low temperature. The reaction is heterogeneous and has a very small energy of activation. Contrary to the case of the oxidation of CO by O obtained by discharge, the efficiency of collisions (on the wall) in the present experiments is large ; this can be explained by the participation of metastable atoms, O′ (^{1}D), obtained during the photodissociation of O_2 together with the normal ones. The kinetics of the reaction have been examined on the assumption that the principal process takes place according to the equation : $CO_{ads} + O' \rightarrow CO_2$. The correlation between the constants of the reaction and the isotherm of the adsorption of CO on quartz has been arrived at. AUTHOR.

626. Photochemical Oxidation of Nitrogen. V. Kondratjew. *Acta Physicochimica*, 3. 2–3. *pp.* 247–253 ; *Disc.*, 254, 1935. *In English.*—A series of experiments is made on the photochemical oxidation of N_2 and CO by O_2 and of CO by NO, as well as on the dissociation of NO by radiation from a quartz mercury arc. An increase in the yield of NO_2 by the addition of CO and H_2 to the mixture of N_2 and O_2 is found.

The possible mechanisms to explain the oxidation of N_2 and the influence of admixtures are discussed. AUTHOR.

627. Theory of Photochemical Reactions and Chemiluminescence in Solutions. B. Sveshnikoff. *Acta Physicochimica*, 3. 2–3. *pp.* 257–268; *Disc.*, 268, 1935. *In English.*—Deals with the dissipation of energy when due to collisions of the second kind between an excited molecule and another molecule of the same or some other substance. As a result of an investigation of the quenching of fluorescence by foreign substances, the theory developed by Frank and Wawilow [see Abstract 3054 (1931)] was found to require modification. The development of the modified formula is given, but does not result in an agreement between calculated and observed results, the probable causes of this disagreement being discussed. The low efficiency of chemiluminescence processes is probably due to the quenching of the excited molecules by the unexcited ones, and the influence of viscosity on these processes is examined. The results obtained show that the rate of the reaction changes considerably with viscosity, and the sum of light increases rapidly with the transition from water to water-glycerin solution. Formaldehyde is found to be an essential constitutent of the water-glycerin mixture for radiation of any magnitude to be obtained, and the intensity of the radiation is apparently proportional to the concentration of the formaldehyde. R. C. F.

628. Photochemistry of Crystals. M. Savostjanova. *Acta Physicochimica*, 3. 2–3. *pp.* 345–354; *Disc.*, 354, 1935.—A review of the subject under the sections: (1) Atomic and colloidal distribution, in which the light effect is correlated with the nature of the photochemical products. (2) Products of the primary photochemical reaction, in which the alkali and silver halides are discussed. It is concluded that colloidal particles, of dia. $\geqslant 30m\mu$ (for AgCl), are formed under the influence of light, and that the particle size depends on the intensity of the active light. (3) Secondary photochemical reactions, such as the fading which occurs in these crystals. (4) The photochemistry of silver salts. In the *Discussion*, **E. Schpolsky** dealt with the dependence of the quantum yield on temperature in the case of the alkali halide crystals and the electron transition from the anion to an adjacent kation. **E. Zehnovitzer** considered "metal fog."
H. H. Ho.

629. Optical Sensitisation of Photochemical Reactions in Solids. A. J. Rabinovitch. *Acta Physicochimica*, 3. 2–3. *pp.* 368–382, 1935. *In English.*—Only a few cases of optical sensitisation in solids are known and these are briefly enumerated with particular mention of the sensitisation of AgBr by dyes. The adsorption of sensitisers, shift of sensitisation maximum, influence of dyes on the blue sensitivity, influence of the dye concentration and the energy of sensitisation are then discussed in connection with the high yields of sensitisation. A survey of the theories of optical sensitisation is made in order to choose those which might be applied to sensitisation in solids, and the theories dealing with collisions of the second kind, with chemical complexes, and with photo-activation of the sensitisers, are considered to be the most suitable. The experimental data are, however, insufficient to allow of a definite choice being made. Finally, a new hypothesis is suggested which indicates the importance of photo-oxidation of adsorbed sensitisers by the oxygen in the air, and it is assumed that the energy evolved in this reaction is utilised for the decomposition of the solid crystals. R. C. F.

630. Effect of Wave-Length on the Iodine-Sensitised Decomposition of Ethylene Iodide in Carbon Tetrachloride Solution. R. G. Dickinson and N. P. Nies. *Am. Chem. Soc., J.* 57. *pp.* 2382–2386, *Dec.*, 1935.—The dependence on wave-length of the rate of iodine-sensitised decomposition of $C_2H_4I_2$ in CCl_4 solution is re-examined. In view of the lack of proportionality between rate and intensity, absorption coefficients are measured and special attention is given to the distribution of intensity through the solutions. The wave-lengths used are 4358, 5461, and 5770 and 5790 Å; for these three radiations the relative values of the rate-constant at 76·6° are found to be 1 : 0·931 : 0·867. The results indicate that light corresponding to continuous absorption in gaseous I_2 is slightly more effective in bringing about dissociation of iodine in the solution than light corresponding to the discontinuous absorption, but that the difference is not large. Absolute values of the empirical specific rate constant are measured. AUTHORS.

631. Photochemical Decomposition of Ethylene Iodide in Solutions of Carbon Tetrachloride. R. E. DeRight and E. O. Wiig. *Am. Chem. Soc., J.* 57. *pp.* 2411–2415, *Dec.*, 1935.—The apparent quantum yield for the photo-decomposition of $C_2H_4I_2$ in CCl_4 solutions by light of wave-lengths 303 and 313 $m\mu$ is found to be 0·76. This includes both the photo- and any subsequent thermal reactions. A mechanism involving a primary dissociation into C_2H_4I and atomic iodine is suggested. The rate equation based on this mechanism is in agreement with the data obtained. A further study of this reaction should be of interest in connection with the Franck and Rabinowitsch theory of photochemical reactions in solution. AUTHORS.

632. Blackening Law of Photographic Plates. H. Kienle. *Naturwiss.* 23. *pp.* 762–767, *Nov.*, 8, 1935.—The reciprocity law and Talbot's law generally are not valid for photographic plates, thus causing the difficulties which appear in photographic photometry. Results are given for reciprocity law failure and intermittency effect for four different emulsions over a wider range than previously used. The results show that the reciprocity curves are, for the same time of illumination, parallel to one another, and the critical frequency is independent of the wave-length. With panchromatic films an intensity change of from 1 to 4 only results in a blackening increase of from 0·79 to 1·14. An examination of the temperature effect shows that although the reciprocity curves are considerably affected by temperature, yet for each temperature they remain parallel to one another for all wave-lengths. [See also Abstracts 4470 (1933), 2461 (1934) and 687 (1935).] R. C. F.

633. Effect of Sodium Salicylate on Photographic Contrast. Tien Kiu. *Comptes Rendus*, 201. *pp.* 1348–1350, *Dec.* 23, 1935. *In French.*—Certain Lumière and Guilleminot plates are bathed in solutions of sodium salicylate of varying concentrations and a study is made of the resulting contrast factors for radiations between λ 4000 and λ 2500. It is found that the contrast factor varies with the concentration of the solution, that the sensitivity of the plates is considerably increased and is more uniform with wave-length. A. H.

634. Mechanism of the Desensitisation of Photographic Plates. Part II. Marietta Blau and Hertha Wambacher. *Zeits. f. wiss. Phot.* 34. *pp.* 253–266, *Nov.*, 1935. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 7–8. *pp.* 403–408, 1935.—Examines the way in which the blackening curves of

desensitised photographic layers are changed by the oxygen content of the surrounding medium, and by the concentration of the desensitiser. The results obtained show that oxygen plays a very important part in the blackening sensitivity, solarisation, and bleaching-out sensitivity of desensitised photographic plates. The desensitising material influences the value of the oxygen effect, and is very marked for pinakryptol yellow, the desensitiser used in these experiments. [For Part I see Abstract 685 (1935).] R. C. F.

635. Minimum Useful Gradient as a Criterion of Photographic Speed. L. A. Jones and M. E. Russell. *Kodak Research Lab., Comm. No.* 556. *J.O.S.A.* 25. *pp.* 396–411, *Dec.*, 1935. *Phot. J.* 75. *pp.* 657–675, *Dec.*, 1935.—The two criteria, inertia and fixed density, which have been used to express numerically the speed of a photographic material are not entirely satisfactory. The present authors discuss the possibility of using a third criterion—the minimum limiting gradient. This has not been used before owing to the difficulty of determining the exposure corresponding to a specified minimum gradient, but a gradient photometer of the differential type is described which simplifies this determination and gives results of high precision. Actually it is not proposed to use a constant value of minimum gradient, but a value which is some function of the maximum gradient to which the material is developed, and in order to illustrate the applications of the method the exposure required to produce a gradient equal to $\frac{1}{2}$ maximum gradient is used. The superiority of the criterion over the more generally used criteria is fully discussed and results obtained from fifty different amateur negative materials are given, illustrating the relation between speed numbers determined by the three possible methods. Finally, tentative specifications for the measurement of speed in terms of minimum limiting gradient are given. R. C. F.

636. Deviations from Schwartzschild's Law. M. Lambrey and J. Corbière. *Comptes Rendus*, 201. *pp.* 1351–1352, *Dec.* 23, 1935.—It is found that with Lumière blue extra rapid plates the Schwartzschild constant p is not constant even over the restricted region of wave-lengths 4300–3230—varying not only with λ but with intensity and time of exposure. The variation with intensity and time is most marked with the shorter wave-lengths. J. E.

637. Pressure Effect on Sensitivity of Photographic Films. Ny Tsi-Zé and Lü Ta-Yuan. *J.O.S.A.* 26. *pp.* 26–29, *Jan.*, 1936.—The effect of pressure on photographic sensitivity is studied with the monochromatic radiations of a quartz mercury arc for four different films of Eastman Kodak Company; namely, Kodalith, motion picture positive, commercial, and portrait films. The quantity E/E_e, where E is the illumination actually used when the emulsion is under pressure, and E_e the illumination which would be required to produce the same optical density when the emulsion is under no pressure, is a function of pressure only and, for pressures greater than 250 kg./cm^2., E/E_e is a linear function of the pressure. The variation of E/E_e with the wave-length of the radiations is very similar to that of the contrast for all the films studied. It is pointed out that the pressure effect on photographic sensitivity may be closely related to the absorption properties of the emulsion. AUTHORS.

638. Picture Reversal with Silver and Mercury Iodides. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 34. *pp.* 292–304, *Dec.*, 1935.—Discusses the question of picture reversal obtainable with AgI emulsions [see Abstract 2063 (1935)] and HgBr emulsions, considering previously published results

and dealing with effect of exposure on reversal, the action of oxygen on desensitisation, desensitising by light, and solarisation and germination.
R. C. F.

639. Interrupted Photographic Exposure. C. C. Long, F. E. E. Germann and J. M. Blair. *J.O.S.A.* 25. *pp.* 382–383, *Dec.*, 1935.—Certain photographic emulsions, if allowed to rest after initial exposure to intense radiations and then re-exposed to the same radiation, undergo a reduction of developable density produced by the first exposure when the second exposure is short, but if it is prolonged the density again increases. This reduction in density seems to depend upon the spectral composition of the light for it does not occur with both initial and secondary exposures to white light or with a white light initial exposure and a secondary exposure to light of green and longer wave-lengths. Temperature may play a part and preliminary results seem to indicate that a larger decrease in density is obtained with greater intensities of exposing light. A number of rest periods produce little, if any, greater decrease in density, unless the secondary exposures are long, when later rest periods are followed by a decrease in density. This reduction in density during the early part of the secondary exposure may be due to the fading, during the rest period, of an activation which promotes a forward reaction. R. C. F.

***640. Electric Driving and Timing Apparatus for Microkinematography. A. Goetz and A. Romer.** *Rev. Sci. Instruments*, 7. *pp.* 6–11, *Jan.*, 1936.—The apparatus described serves as an electric drive of a motion picture camera. It permits, in contradistinction to other devices for the same purpose, the independent adjustment of the exposure time and the interval between the exposures. The former can be adjusted between 0·2 and 5 sec., the latter continuously over a range of a factor 5000. Two applications of this apparatus in the field of microkinematography are described, one being the determination of the falling speed of suspended colloid particles in an ultramicroscope, the other being the recording of the growth of etch figures on crystal planes produced by electrolysis. AUTHORS.

***641. Eastman Transmission and Reflection Densitometer. C. A. Morrison and J. W. McFarlane.** *Kodak Research Lab., Comm. No.* 561. *J.O.S.A.* 25. *pp.* 417–419, *Dec.*, 1935.—Describes a new instrument which is a combination of the transmission densitometer developed by Capstaff and Purdy, and McFarlane's modification to make it suitable for the measurement of reflection densities [see Abstract 610 (1934)]. The transmission density range is 0 to 3 with a circular measured area 0·5 mm. dia., and the reflection density range is 0 to 4, the measured area being 4 mm. dia. R. C. F.

***642. Realisation of Undeformable Cellulose Acetate Films for Photography. A. Charriou and Suzanne Valette.** *Phot. J.* 76. *pp.* 27–31, *Jan.*, 1936.—Gives the results of an investigation undertaken to produce an undeformable film, the best results being obtained by using cellulose acetate containing about 60 % of acetic acid, plasticised with triphenyl phosphate and dissolved in methylene chloride-ethanol, the films being left in a stove at 100° C. for 4 hr. The results given deal with the influence of chemical composition—proportion of plasticisers and acetic acid, and influence of after-treatment—treatment of films by water and heat. Finally, the interpretation of these results is considered, it being shown that the above method results in a film which has normal

transparency and elasticity and can be soaked in water without deformation even after drying for 3 months. R. C. F.

See also Abstracts 480, 652, 691, 696, 723, 728, 812.

PHOTOMETRY.

643. Errors Due to Small Colour Differences in Photometry. H. König. *Helv. Phys. Acta*, 8. 8. *pp.* 637–650, 1935.—A theoretical discussion of the errors likely to be introduced in the photometric comparison of two sources, both having approximately black-body spectral distributions but differing slightly from true grey bodies. Although the errors introduced under ordinary conditions are quite small, if the luminosity curve of the observer's eye differs markedly from the international standard curve, errors of the order of 1 % may be committed. Slight departures from black-body distribution are found in filament lamps and still greater departures are introduced when a blue glass is used to match a given lamp with one of higher colour temperature. In such cases the errors examined by the author may occur with certain observers. J. W. T. W.

***644. Visual Photometers. R. Sewig.** *A.T.M.* 5. *T*153–154, *Nov.*, 1935.—A brief description of the principal instruments in use at the present time, including a new polarisation photometer and the Gehlhoff-Schering telephotometer. J. W. T. W.

***645. Errors in Guthnick Photoelectric Photometer. E. J. Meyer.** *Zeits. f. Astrophysik*, 11. *pp.* 113–116, *Dec.* 15, 1935.—In order to trace the cause of errors arising in determinations made with a Guthnick photoelectric photometer for the measurement of stellar photographs, experiments are made which show that the sensitivity of the photo-cell apparently varies over the surface of the kathode. The effect is shown to be due to non-uniformity of the transmission of the window of the cell, and the resulting errors can be eliminated by interposing in the beam a strongly diffusing screen in front of the cell. D. H. F.

See also Abstracts 567, 568, 569, 603, 632, 635.

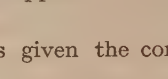
POLARISATION.

646. Ultra-Violet Rotatory Dispersion of Solutions of Camphor in Various Acids. J. Lecompte and J. Perrichet. *Rev. d'Optique*, 14. *pp.* 390–397, *Nov.*, 1935.—Using a modified Cotton-Descamps spectro-polarimeter, the rotatory dispersions of solutions of camphor in various organic and mineral acids are measured at ultra-violet wave-lengths. The results, which are analysed with the help of a Darmois diagram, indicate the existence of at least three forms of camphor in sulphuric acid solutions. C. B. A.

647. Optical Behaviour of Dissolved Ions and Structure of Electrolytic Solutions. Part II. Optical Rotatory Power of the Methyl - propyl - phenyl - benzyl - ammonium Ion. G. Kortüm. *Zeits. f. phys. Chem.* 31. *Abt.B.* 1–2. *pp.* 137–151, 1935.—The conclusions reached on the basis of absorption measurements on strong electrolytes in very dilute solution [see Abstract 218 (1936)] are confirmed by measurements of the specific rotatory power of a tetra-alkyl-ammonium ion under various conditions of concentration, solvent, and added salts. Kations of the type NR_4^+ seem to be most suitable, since they may be considered

as coordinatively saturated, and serious effects due to homopolar binding forces with other ions or solvent molecules are not to be expected. C. B. A.

648. Absolute Configuration of Lactic Acid. W. Kuhn. *Zeits. f. phys. Chem.* 31. *Abt.B.* 1–2. *pp.* 23–57, 1935.—With the help of a model for methyl ethyl carbinol, an absolute configuration is proposed for lactic acid. In the model, the CH_3- and C_2H_5-groups and the active C-atom are represented by isotropic resonators of suitable charge whose interactions are calculated, whilst the OH is treated in turn as isotropic or an anisotropic with various vibration directions. When the OH vibration of longest wave-length is an isotropic, optical activity appears as a second-order effect, but it disappears in this order if the vibration is isotropic.

d(−)—Lactic acid is given the configuration  , the groups joined by the broken line lying below the plane of the paper. The nature of the vibrations producing the optically-active absorption bands, and the relationship of their anisotropy to the appearance of activity, are discussed. C. B. A.

649. Theory of Optical Activity. B. Y. Oke. *Roy. Soc., Proc.* 153*A*. *pp.* 339–352, *Jan.* 1, 1936.—A system of four identical vibrators at the corners of a tetrahedron, mutually interacting, gives five different characteristic frequencies. If one pair of vibrators is twisted round the line of centres, the distorted system becomes optically active. The angle of optical rotation is calculated in terms of the five characteristic frequencies, the edge of the tetrahedron, and the angle of twist. [See Abstract 2523 (1935).] AUTHOR.

***650. Method for Making and Testing Quarter-Wave Plates. R. M. Emberson.** *J.O.S.A.* 26. *pp.* 63–64, *Jan.*, 1936.—A test for quarter-wave plates is described which requires only a light source and collimator, half-silvered mirror, Nicol prism, and full-silvered mirror. The test is sensitive and does not require a quarter-wave plate for comparison or other purposes. A mechanism is described for tilting mica sheets of approximately correct thickness so that they become effective quarter-wave plates. AUTHOR.

***651. Photoelectric Half-Shade Method for Determining Rotatory Dispersion. O. Schönrock and E. Einsporn.** *Phys. Zeits.* 37. *pp.* 1–12, *Jan.* 1, 1936. *From the Reichsanstalt.*—A photoelectric half-shade method for measuring rotatory dispersions is described. It makes use of a rotatable polariser, a Woolaston prism, and a continually rotating analyser. Systematic errors are investigated, and the accuracy of the method is demonstrated by measurements on quartz which agree closely with those of Lowry and Coode-Adams. C. B. A.

652. Photographic Plates and Rectilinearly Polarised Light. G. Bolla. *N. Cimento*, 12. *pp.* 510–515, *Aug.-Sept.-Oct.*, 1935.—Photographic plates illuminated obliquely reflect light polarised in the plane of incidence in greater proportion than light polarised in the plane at right angles to that of incidence. In consequence the photographic plates used with oblique incidence acquire the quality of imperfect analysers. Two equal illuminations, acting for equal intervals of time, and obtained the one with light polarised in the plane of incidence, the other with light polarised in the plane at right angles to the plane of incidence, give different blackenings. J. J. S.

See also Abstracts **384, 452, 566, 619, 667.**

RADIATION, EMISSION.

653. Ionosphere, Skip Distances and Micro-Waves. E. O. Hulburt. *I.R.E., Proc.* 23. *pp.* 1492–1506, *Dec.*, 1935.—A detailed description of the ionosphere is given based on the recent measurements of the National Bureau of Standards and the Department of Terrestrial Magnetism of the Carnegie Institution. From the ionosphere data the skip distances of radio waves are calculated for temperate and tropical zones, with the diurnal and seasonal changes. The values agree with the observed values as far as they are known. It is concluded that daylight short-wave communication is controlled by the E-region in summer and by the F-region in winter. Theory indicates that the observed bending of micro-waves over the horizon, and hence the successful micro-ray communication to a distance of 200 km., is due to diffraction of the micro-waves over the bulge of the earth and to temperature gradients in the lower atmosphere. AUTHOR.

654. Influence of the Radiation Field from an Electrical Storm on the Ionisation Density of the Ionosphere. R. H. Healey. *Phil. Mag.* 21. *pp.* 187–198, *Jan.*, 1936.—The methods developed by Bailey and Martyn in their consideration of the influence of electric waves on the ionosphere have been applied to the situation where a highly damped electric wave lasting a few milliseconds acts on the ionosphere. Use is made of the results of Townsend and Tizard and of Sanders on the motions of electrons in air to show that the increase in ionisation density of the ionosphere due to the radiation field of a lightning flash alone is inappreciable. A note by **V. A. Bailey** is appended. AUTHOR.

655. Cosmic Ray Cloud-Chamber Measurements at Jungfraujoch. G. Herzog and P. Scherrer. *J. de Physique et le Radium*, 6. *pp.* 489–495, *Dec.*, 1935.—161 exposures containing 383 tracks are taken with a large cloud chamber, about half being taken at random and the rest automatically under counter control. A curve of the distribution of energy among the softer rays (up to 80×10^6V) is obtained. The tracks of 17 pairs of positive and negative electrons are examined, and the partition of the total energy of the pair between the individuals found to fit in with Bethe and Heitler's calculations [see Abstract 3411 (1934)]. 152 tracks of particles with energies greater than 50×10^6 were observed, but the energies of a few only of these could be determined, the magnetic field not being large enough. Two unusual sets of tracks which are difficult to explain are recorded, and there was also one track thought to be due to a proton, of undeterminable sign. D. H. F.

656. Cosmic Ray Measurements in Franz Josef Land. J. Scholz. *Gerlands Beitr. z. Geophys.* 45. 4. *pp.* 377–380, 1935.—Ionisation measurements with a Kolhörster chamber showed that, in addition to the barometric effect, there was an appreciable increase in ionisation with increasing density of the surrounding air. D. H. F.

657. Variation of Intensity of Cosmic Rays Between Amsterdam and North Cape. J. Clay, C. G. 'T Hooft and P. H. Clay. *Physica*, 2. *pp.* 1033–1039, *Dec.*, 1935. *In English.*—The intensity of cosmic radiation was recorded with two different ionisation instruments on board the shop *Costa Rica*. No variation larger than 0·6 % was found between Amsterdam 54° M.L. and North Cape 67° M.L. Only near the coast of Norway at the latitude of Bergen, 58° M.L. there seems to be a defect of 1 or 2 %. When the ship was in a fjord the shielding of the mountains

was noticeable. The variation was also recorded by two sets of three coincidence Geiger counters. AUTHORS.

658. Cosmic Ray Ionisation in Deep Water. J. Clay and C. G. 'T Hooft. *Physica*, 2. *pp.* 1039–1041, *Dec.*, 1935. *In English.*—An arrangement for measuring very low ionisation currents is described and used for determining the ionisation due to cosmic rays under 100 m. of water. AUTHORS.

659. Decrease of Primary Cosmic Radiation and Showers in Water Down to a Depth of 300 M. J. Clay and P. H. Clay. *Physica*, 2. *pp.* 1042–1050, *Dec.*, 1935. *In English.*—The threefold coincidences of Geiger counters in vertical position are measured down to a depth of 300 m. of water. At sea level the number of coincidences is 7 per min., under 300 m. it is about 1/800 of this value. The decrease of these coincidences is approximately parallel with the decrease of ionisation, so that it may be concluded that the whole primary radiation is corpuscular. For primaries reaching a depth below 100 m. the situation may be different. The decrease of showers is measured down to 100 m., by means of three counters in triangular arrangement surrounded by a lead cylinder of 12 mm. thickness and an iron cylinder of 6 mm. The numbers of showers and primaries are parallel between 2 and 100 m. of water. This leads to the supposition that there is only one kind of primary corpuscles, and that the shower-producing radiation is a secondary radiation from the primary corpuscles of low energy. AUTHORS.

660. Cosmic Radiation under 28 m. of Earth. P. Auger and A. Rosenberg. *Comptes Rendus*, 201. *pp.* 1116–1118, *Dec.* 2, 1935.—Counter measurements of the absorption of cosmic radiation by Pb, in thicknesses up to 10 cm. are made under 28 m. of earth, corresponding to 70 m. of water below the top of the atmosphere. It is concluded that the softer of the two components postulated by these authors in a previous paper [see Abstract 2529 (1935)] is reduced to about 3 % of the whole and that the secondaries produced are very soft. The coefficient of absorption of the harder component is less than at sea level and the results indicate that the mass-absorption of Pb and of earth for this component is approximately the same. D. H. F.

661. Sign and Nature of Ultra-Penetrating Particles of Cosmic Radiation. L. Leprince-Ringuet. *Comptes Rendus*, 201. *pp.* 1184–1187, *Dec.* 9, 1935.—Cosmic radiation is passed first through a Wilson chamber 55 × 15 cm., in which it is subjected to a magnetic field of 13,000 gauss, and then through two counters, 7 cm. of Pb, and finally through a third counter. Of some 60 trajectories that reach the third counter about one-third are practically straight, indicating particles of very great energy; in the rest, the minimum energy of which was 7×10^8 eV, there are about two positive to one negative. These results, while they do not exclude explanations are not inconsistent with existing views [see Abstract 3005 (1935)]. C. A. S.

662. Analysis of Penetrating Radiation. B. Gross. *Phys. Zeits.* 37. *pp.* 12–18, *Jan.* 1, 1936.—On the basis of the experimental absorption curve for penetrating radiation, expressions are deduced for the rate of loss of energy of the primary corpuscles, and the formation and properties of secondary radiations are examined. F. C. C.

***663. Mercury Lamp for Intense Resonance Radiation. G. Kornfeld and F. Müller-Skjold.** *Zeits. f. phys. Chem.* 31. *Abt.B.* 3. *pp.* 223–226, 1936.—The tube is made of silica and the electrodes of

tungsten. Water-cooling is provided for each electrode and the lamp is excited by 220 V. The kathode is coated with a mixture of $BaCO_3$ and $SrCO_3$, and heated with current from a step-down transformer. The energy output for the 2537 Å line was measured with a monochromotor and thermopile and found to be about 12 times that from the usual form of lamp. F. S.

***664. Source of Radiation for Visible and Infra-Red. A. H. Pfund.** *Science*, 82. *pp.* 597–598, *Dec.* 20, 1935.—A portion of Welsbach mantle is heated in the glow or arc discharge from the secondary of a transformer, high intensities being used for the visible and near infra-red and low intensities for the far infra-red where the mantle shows selective emission. The mantle is mounted in a pyrex tube with windows of quartz and rocksalt. The gas pressure is reduced, good results having been obtained at 20 cm. pressure and a current of 40 mA. F. S.

See also Abstracts 766, 872.

RADIATION, GENERAL THEORY.

665. Neutrino Theory of Light. O. Scherzer. *Zeits. f. Physik*, 97. 11–12. *pp.* 725–739, *Nov.* 25, 1935.—Assuming the light quant to consist of two neutrinos, a Hamiltonian function is laid down which is similar to Dirac's Hamiltonian function in the usual radiation theory, but with a modified expression for the interaction energy between radiation, and matter to allow for the fact that in every optical process two neutrinos take part. The theory gives correctly the spontaneous emission, absorption, finite velocity of propagation, scattering and interference of light. Although induced emission is absent, a neutrino field in thermodynamic equilibrium acts on the atoms precisely as a light quant field with Planckian radiation density. Difficulties connected with the common propagation direction of the two neutrinos taking the place of a single light quant remain unexplained and the infinite self-energy of the electron also follows from the theory. W. S. S.

666. Interpretation of the Coefficient of Fine-Structure. S. A. de Mayolo. *Comptes Rendus*, 201. *pp.* 1097–1099, *Dec.* 2, 1935.—The author gives an interpretation of α on his theory of the electromagnetic field [see Abstract 2537 (1935)]. This constant there appears as the quotient of the charge of electron by a charge characteristic of the electromagnetic field and depending on h. G. C. McV.

See also Abstracts 724, 872.

REFLECTION. REFRACTION AND DISPERSION.

667. Surface Properties of Spar. R. de Mallemann and F. Suhner. *Comptes Rendus*, 201. *pp.* 1344–1346, *Dec.* 23, 1935.—Linearly polarised light is reflected from the surface of crystals and prisms of spar, the change in the nature of the reflected light with alteration of the angle of incidence being studied. The observations are found to be accountable for quantitatively if it be assumed that there is an isotropic transition layer on the surface of the specimens. A. H.

668. Refraction of Electrolyte Solutions. Part IV. Full Curve of KCl. A. E. Brodsky and N. S. Filippowa. *Zeits. f. phys. Chem.* 31. *Abt.B.* 3. *pp.* 227–236, 1936.—By interferometry [see Abstract 631 (1934)] and the Pulfrich refractometer, the refractive index of the solution is found at 25° C. for concentrations varying from 0·001 to 1·4 *N*. The results are

obtained by stepping up from a lower to a higher concentration of solution and measurements of change in refractive index are made to 2×10^{-7} and the specific gravity is obtained by a pyknometer to 1×10^{-6}. The results are in good agreement with earlier experiments which were obtained chiefly by refractometer methods for high concentrations. H. M. B.

669. Refractive Dispersion of Organic Compounds. Part VII. Refractive Indices of Hexane and Refractivities of Hydrogen and Carbon. Significance of the Dispersion Constants. Part VIII. Isomers of the Formula $C_4H_8O_2$: Dioxan, Ethyl Acetate, *iso*-Butyric Acid and Acetoin. C. B. Allsopp and H. F. Willis. *Roy. Soc., Proc.* 153*A*. *pp.* 379–406, *Jan.* 1, 1936.—The physical basis of the law of additivity as applied to molecular refractions is examined. The refractivity of a molecule may be expected to be the sum of the refractivities of its component atoms only when its refractive indices can be represented by a dispersion equation containing a single variable term with a characteristic frequency in the Schumann region. This is confirmed by the present measurements. Refractive indices and molecular extinction coefficients over a wide range of wave-lengths are recorded for all the compounds, and refractivities are deduced for carbon, hydrogen and oxygen. The use of the Ketteler-Helmholtz dispersion equation in the case of liquids is examined. Comparison of the refractive dispersions of acetoin and cyclohexanone suggests that the partial refractions of the absorption bands of organic molecules are not necessarily proportional to the *f*-values. [For Parts V and VI, see Abstracts 3713 and 3714 (1934).] C. B. A.

670. Dispersion of Air, Krypton and Xenon in the Short-Wave Ultra-Violet. W. Kronjäger. *Zeits. f. Physik*, 98. 1–2. *pp.* 17–22, *Nov.* 30, 1935.—The dispersion of air, Kr and Xe in the short wave ultra-violet is measured. A two-membered dispersion formula is derived which gives absorption frequencies of shorter wave-lengths than those of Cuthbertson. W. R. A.

671. Optical and Electrical Characteristics of Didymium Glass. K. Prosad, D. K. Bhattacharya and L. M. Chatterjee. *Zeits. f. Physik*, 98. 5–6. *pp.* 324–335, *Dec.* 23, 1935.—Some peculiarities of didymium glass were investigated. The fluorescence bands of didymium glass illuminated by the sun are identical with the Raman spectrum, if the frequencies of the strong absorption bands which didymium glass is known to possess are regarded as incident exciting frequencies. The infra-red frequencies calculated on this hypothesis agree markedly with the known values for glasses, as found by other investigators. Three new hitherto not given frequencies were found at $2{\cdot}5$, $3{\cdot}1$, and $6{\cdot}0\mu$. The photo-electric conductivity of didymium glass was investigated with the object of explaining a characteristic difference of the fluorescence bands which are emitted on solar irradiation without filter or with a yellow or blue filter. The results showing greater photoelectric conductivity in white light support the authors' hypothesis. J. J. S.

672. Refraction of Tempered Plate Glass. J. J. Hopfield and G. B. Watkins. *J.O.S.A.* 26. *pp.* 24–25, *Jan.*, 1936.—It is found that the refractive index of heat-strengthened plate glass diminishes continuously from surface to centre. As a consequence (1) prisms of such glass form spectral lines that are greatly curved, (2) plates of glass with plane parallel ends refract like cylindrical, concave lenses. This change of refraction is probably due to the condition of strain in the glass rather than to a relative change in the concentration of the component oxides. AUTHORS.

***673. Numerical and Graphical Method for Computation of Two-Component Lens Systems. H. Werner.** *Zeits. f. Instrumentenk*, 55. *pp.* 481–485. *Dec.*, 1935.

***674. Prism Producing 90° Deviation and Corrected for Polarisation Effects. M. Berek.** *Zeits. f. Instrumentenk.* 56. *pp.* 1–6, *Jan.*, 1396. —A prism is described which whilst producing 90° deviation is corrected for disturbances of the state of polarisation of a beam of small aperture. It is suitable for use in measurements of the optical properties of absorbing anisotropic crystals particularly in metallurgical and ore microscopy. C. B. A.

***675. Self-Illuminating Lenses. A. Kühl.** *Zeits. f. Instrumentenk.* 56. *pp.* 6–15, *Jan.*, 1936.—A detailed investigation of the properties of this type of lens [see Abstract 633 (1934)]. C. B. A.

See also Abstracts 641, 744, 745, 779.

SPECTROSCOPY.

676. Far Ultra-Violet Spectra of Sulphur and Tellurium. L. and E. Bloch. *J. de Physique et le Radium*, 6. *pp.* 441–450, *Nov.*, 1935.—In continuation of Goudet's work on Se [see Abstract 4999 (1935)], the spectra of S and Te due to an oscillating discharge have been measured. Standard lines were obtained by the introduction of oxygen, and an accuracy of about 0·01 Å is claimed. Tables of wave-lengths are given for S to 328 Å and for Te to 157 Å. A considerable number of lines have been classified. F. S.

677. Arc Spectrum of Rubidium. K. W. Meissner. *Zeits. f. Physik*, 98. 5–6. *pp.* 353–354, *Dec.* 23, 1935.—The results of a recent investigation of the arc spectrum of Rb by Datta and Bose [see Abstract 4997 (1935)] are criticised adversely. It is pointed out that the splitting of the D term which they noted was measured several years ago with greater accuracy by Ramb [see Abstract 3818 (1931)]. Contrary to the findings of Datta and Bose the 3 D term is known to be double. J. E. K.

678. Spark Spectrum of Cadmium. R. Ricard and A. Saunier. *Comptes Rendus*, 201. *pp.* 1115–1116, *Dec.* 2, 1935.—Wave-length measurements were made, in the region 3400–5000 Å, of the spectrum of the electrodeless discharge in Cd vapour. A list of lines appearing in the Cd III and Cd IV spectra is given ; it contains a number of new lines and also a number of old ones re-determined to a greater accuracy. D. H. F.

679. Second Spark Spectrum of Mercury. R. Ricard. *Comptes Rendus*, 201. *pp.* 1342–1344, *Dec.* 23, 1935.—An electrodeless discharge is employed and a large number of lines in the visible and near ultra-violet are ascribed to some 30 terms of Hg III. A. H.

Pressure Effects on Spectral Lines. H. Margenau and W. W. Watson. *Rev. Modern Physics*, 8. *pp.* 22–53, *Jan.*, 1936.—Section (1) of this review deals briefly with the various causes of width and displacement of lines, namely (*a*) radiation damping, (*b*) Doppler effect, (*c*) resonance between similar atoms, (*d*) van der Waals forces of foreign atoms or molecules, (*e*) foreign perturbers (ions, dipoles or multiples) with permanent fields. The remainder of the review is mainly devoted to detailed discussions of (*c*) and (*d*), and is divided into sections dealing in turn with (2) experimental methods of determining intensity distributions, (3) general methods of calculating intensity distributions when perturbations depend upon time, (4) van der Waals interactions, (5) resonance interactions, (6) true intensity distribution, statistical frequency, distribution

and velocity-broadening distribution, (7) impact theories and their experimental verification, (8) statistical theories, (9) broadening with pronounced asymmetries and shifts, (10) shifts of the higher members of series of the alkali atoms. An extensive Bibliography is provided, which, however, does not include earlier papers covered by Weisskopf's 1933 review. W. J.

681. Effect of Temperature and Foreign Gas upon the Absorption of Chromyl Chloride. M. Kantzer. *Comptes Rendus*, 201. *pp.* 1030–1031, *Nov.* 25, 1935.—Measurements were made with a 1-m. grating at 20°. The absorptions of an equal number of molecules at various densities are compared. Some lines show increase of absorption as the molecules approach, some decrease of absorption and others show more rapid decrease. Hydrogen when admixed shows an increase in absorption especially at the red end of the spectrum. Other gases have a similar effect, decreasing in effect with their molecular weight. F. S.

682. Analysis of Se II Spectrum. D. C. Martin. *Phys. Rev.* 48. *pp.* 938–944, *Dec.* 15, 1935.—An analysis of the spectrum of Se II is given with additions and corrections to that by Krishnamurty and Rao [see Abstract 1625 (1935)]. The spectrum was excited in a hollow kathode discharge with a helium atmosphere. Wave-length measurements were made in the region 500 to 2600 Å with a 1·5-m. grating vacuum spectrograph. New terms belonging to the $4s^24p^25p$ configuration have been found and identified. Several other terms, probably associated with the $4s^24p^24d$ and $4s^24p^25d$ configurations, have been found and J values assigned, but it has been found impossible at present to assign L and S values to them. Tables of all term values and line classification known at present are listed. AUTHOR.

683. Unsymmetrical Electric Charge Distribution of the $^{201}_{80}$Hg Nucleus. H. Schüler and T. Schmidt. *Zeits. f. Physik*, 98. 3–4. *pp.* 239–251, *Dec.* 14, 1935.—By means of very accurate measurements of the hyperfine structure of the Hg terms $6s6p\,^3P_1$, $6s6p\,^3P_2$, $6s7s\,^3S_1$ and $6s9p\,^1P_1$ the deviations of these terms from the interval rule are determined. From these deviations the quadripole moment of the $^{201}_{80}$Hg nucleus is calculated to be $q = 0{\cdot}5 \times 10^{-24}$. In the calculation account is taken of the fact that in the case of Hg the coupling is not of the pure Russell-Saunders type and relativity correction and a multiplet separation correction given by Wolfe are also made. The positive sign of q indicates that the $^{201}_{80}$Hg nucleus is elongated in the direction of the nuclear spin axis. An exact structure diagram of the important Hg line 5461 Å is given. J. E. K.

684. Line Groups and Fine Structures. Part II. F. Paschen. *Preuss. Akad. Wiss. Berlin, Ber.* 24. *pp.* 430–443, 1935.—In continuation of a previous communication [see Abstract 2412 (1933)] perturbations in the fine structure of the InII spectrum are investigated which arise from a magnetic transformation of narrow line groups due to the action of the magnetic nuclear moment of the atom. Two cases of smaller perturbations are quantitatively treated. A short review is given of the larger perturbations which are followed through to the end state of the transformation. Typical examples of the transformation are shown in reproductions of original spectrograms. Rules are deduced from the theory of Goudsmit and Bacher which considerably simplify the discussion of complicated fine structures. J. E. K.

685. Absorption Coefficients and H Line Intensities. D. H. Menzel and C. L. Pekeris. *Roy. Astron. Soc., M.N.* 96. *pp.* 77–111, *Nov.*, 1935.—A general formula is given for the oscillator strength of an

atomic electron transition; asymptotic expressions for limiting cases are obtained by the method of steepest descents; and Gaunt's limiting formula is verified and extended. The oscillator strength and Einstein probability are tabulated for Lyman, Balmer, Paschen and other H series. The general theory of statistical equilibrium and photoelectric effect is reformulated. Expressions for continuous absorption coefficients for free-free and bound-free transitions are derived, summed over all quantum states, extended to the case of complex atoms, and applied to the calculation of opacity of the solar atmosphere. The electron pressure so derived agrees well with observation. The Rosseland mean opacity coefficient is calculated and extended to the case of a multiply ionisable gas. Opacity due to interaction of H atoms and free electrons is negligible except, perhaps, in atmospheres of very cool stars. Woolley's conclusion, that opacity due to ionisation of metal atoms is 10^{-6} of that expected on Kramers' theory, is false. W. J.

686. Analytical Wave-Functions for Beryllium-Like Atoms. V. Fock and Mary Petrashen. *Phys. Zeits. d. Sowjetunion*, 8. 4. *pp.* 359–368, 1935. *In English.*—Analytical wave-functions of hydrogen-like type are constructed for atoms with four electrons and an arbitrary nuclear charge Z. The energy values are compared with those calculated by D. R. Hartree and W. Hartree [see Abstract 2406 (1935)] by the method of the self-consistent field with and without exchange (Be) and with the observed values (Be, B^{+}, C^{++}, N^{+3}, O^{+3}). A semi-empirical formula for the energy in terms of Z is deduced. AUTHORS.

687. Tables for Determining Atomic Wave Functions and Energies. P. M. Morse, L. A. Young and Eva S. Haurwitz. *Phys. Rev.* 48. *pp.* 948–954, *Dec.* 15, 1935.—Tables have been constructed so that wave functions and energies, for any atomic state having 1s, 2s and 2p electrons, can be computed by variational means. Exchange terms are included, so that singlet and triplet states can be minimised separately. By using the tables a state can be calculated in a few hours. A few of the possible states have been worked out. The best parameters, the total energies and the term values are given for the states $(1s^2)\ ^1S$, $(1s, 2s)\ ^1S, {}^3S$; $(1s, 2p)\ ^1P, {}^3P$; $(1s^2, 2s)\ ^2S$; $(1s^2, 2p)\ ^2P$; $(1s^2, 2s^2)\ ^1S$; $(1s^2, 2s, 2p)\ ^1P, {}^3P$; $(1s^2, 2p^2)\ ^1S, {}^1D, {}^3P$; $(1s^2, 2s^2, 2p)\ ^2P$; $(1s^2, 2^3, 2p^6)\ ^1S$; of the atoms He, Li, Be, B, C, N, O, F, Ne, Na and Mg. The intramultiplet separations have been computed, including the spin-spin interaction when necessary, the check with experiment being fairly satisfactory. By the use of an empirical correction rule, term values can be predicted to within a few hundred wave numbers. AUTHORS.

688. Dissociation of Molecules with Free Valencies. H. Lessheim and R. Samuel. *Phil. Mag.* 21. *pp.* 41–64, *Jan.*, 1935.—Among the oxides and halides of the metals of the second group a good agreement between the energy of excitation of the products of dissociation and the terms of the metal atom obtains always, if the ground-level of the molecule is correlated to the excited term Sp^3P of the metal. Besides the molecules BeF, MgF, CaF, SrF, already examined before, the following have been considered: BeO, MgO; CdF, BeCl, MgCl, CaCl. The results not only establish the repulsive character of the S^2 group, but also, since no perturbation is observed in the bands, the absence of that type of hybridisation which involves more than one term of the metal atom (q-linkage). This is borne out by the crystal structure of the oxides. In all the above molecules, terms whose energy of excitation is larger

than that of the ground-level are automatically correlated to an anomalous term of the metal atom. In the molecules NO, PO, and AsO, the term with an increased energy of dissociation involves a configuration of the corresponding atom of the fifth group, in which one electron is excited to the next shell. A reasonable correlation can be obtained in SbO on the assumption that it behaves similarly, thus showing again that the increase of stability on excitation in these molecules is always due to the excitation of that electron which does not take part in the linkage, but represents a free valency. H. H. Ho.

689. Rotation-Oscillation Spectrum of the Methyl Halides in the Photographic Infra-Red at 1·11μ. H. Verleger. *Zeits. f. Physik*, 98. 5–6. *pp.* 342–352, *Dec.* 23, 1935.—Using the new Agfa infra-red plates the rotation-oscillation spectra of the methyl halides CH_3Cl, CH_3Br, and CH_3I are photographed at 11,000 Å with the high dispersion of a 3 m. grating. The bands show a simple sequence of approximately equidistant lines which exhibit the characteristic variation of intensity to be expected for the $\perp$ bands of such a molecule with triple axes of symmetry. The mean intervals of lines amount to 8·47, 9·39 and 9·61 cm.$^{-1}$ for the three halides Cl, Br, and I. By raising the pressure in the absorption tube the band existing at lower pressure is overlaid by a second band whose intensity and term number increases with rising pressure. The bands are to be ascribed to the combination oscillation ($2\nu_2 + \nu_1$, $2\nu_4$). J. J. S.

690. Structure of the Near Infra-Red Bands of Methane. Part I. General Survey, and a New Band at 11,050 Å. W. H. J. Childs. *Roy. Soc., Proc.* 153*A*. *pp.* 555–567, *Feb.* 1, 1936.—The near infra-red bands of methane, in the region 10,000 to 12,000 Å, have been investigated photographically under high dispersion (4·5 cm.$^{-1}$ per mm.). Two new bands have been discovered, at 10,050 and 11,230 Å, and much new detail obtained in the bands at 11,350, 11,620 and 11,870 Å. The new band at 10,050 Å is investigated in detail and interpreted as the second harmonic of the fundamental at 3·3 μ. From a critical discussion of the spacings in the bands measured by Cooley it has been possible to point out several inaccuracies in the constants of the methane molecule hitherto derived from them. The moment of inertia in the ground state is found to be $5{\cdot}267 \times 10^{-40}$ gm. cm.^{2}, whilst the vibration moment of momentum in the 7·7 μ and 3·3 μ bands is respectively 0·45 and 0·050 (0·048 from Raman spectrum). All the bands, however, show a second-order effect involving terms in Jl which is not included in the theory. The value of ζ is the same in the overtone as in the fundamental. Author.

691. Predissociation of the Oxygen Molecule. P. J. Flory. *J. Chem. Phys.* 4. *pp.* 23–27, *Jan.*, 1936.—In the emission spectrum of the oxygen molecule no bands in the Runge system, $^3\Sigma_u^- \leftarrow {}^3\Sigma_g^-$, having $v' > 2$ have ever been observed. The absence of these emission bands as well as evidence of broadened rotation lines in the $v' > 2$ absorption bands suggests that in the $^3\Sigma_u^-$ state vibration levels above the second undergo predissociation. Rassetti's observations of the fluorescence spectrum of oxygen, as well as recent photochemical results, support this conclusion. Although it cannot be said that any one of these lines of evidence provides rigorous proof that the oxygen molecule predissociates, collectively they present a convincing argument for its occurrence. Radiationless transition from the $^3\Sigma_u^-$ state is doubtless to the $^3\Pi_u$ state formed from normal atoms. On the basis of the present interpretation the initial process in the photochemical reactions of oxygen caused by

light in the region of Schumann-Runge band absorption is the formation of normal ^3P atoms as a result of the predissociation, rather than the reaction of an optically excited molecule with a normal molecule as heretofore has been supposed. AUTHOR.

692. Emission Spectrum of Nitrogen Peroxide. L. Grillet and M. Duffieux. *Comptes Rendus*, 201. *pp.* 1338–1340, *Dec.* 23, 1935. *In French.*—A weak discharge is passed through a rapid current of pure NO_2, and spectrograms are obtained for the region $\lambda\lambda$ 3350–10,200. Apart from known bands and lines due to dissociation products there is observed a 2-branched band at λ5996 and a number of unresolved bands between $\lambda\lambda$ 5000 and 7000. A. H.

693. Emission Spectrum of TeO. Choong Shin-Piaw. *Comptes Rendus*, 201. *pp.* 1181–1183, *Dec.* 9, 1935.—The spectrum is excited in a silica tube with Pt electrodes and provided with side tubes containing Te and $KMnO_4$ respectively. The tube is evacuated and the side tubes heated so that TeO is formed. About 30 bands are found between 3190 and 3820 Å, degraded towards the red. The bands are analysed and an expression given for the frequency of the band-heads. Comparison is made with results for the molecules O_2, SO and SeO. F. S.

694. Overtone Absorption Bands of Gaseous HF. D. E. Kirkpatrick and E. O. Salant. *Phys. Rev.* 48. *pp.* 945–947, *Dec.* 15, 1935.—With a 21-ft. grating, the structure of the $3 \leftarrow 0$ and $4 \leftarrow 0$ vibration-rotation absorption bands of gaseous HF is observed and the lines measured. The vibrational constants of the molecules are, using also Imes' measurements of the $1 \leftarrow 0$ band: $\omega_e = 4141{\cdot}305$, $x_e\omega_e = 90{\cdot}866$, $y_e\omega_e = 0{\cdot}921$. These constants do not permit evaluation of the energy of dissociation, but the simple Birge formula gives rough agreement. Rotational constants are compared with those obtained from the fundamental band and agree, in general, satisfactorily. No evidence of associated molecules is observed in the overtone bands. AUTHORS.

695. Quantitative Absorption Measurements on the CH-Overtones of Simple Hydrocarbons. Part I. Halogen Derivatives of Methane, Ethane and Ethylene. B. Timm and R. Mecke. *Zeits. f. Physik*, 98. 5–6. *pp.* 363–381, *Dec.* 23, 1935.—The total absorption intensity of the third CH-overtone ($v = 4$) is determined photographically between $0{\cdot}8$ and $0{\cdot}9\ \mu$ for 18 halogen derivatives of CH_4, C_2H_6 and C_2H_2. In extension of earlier calculations of Dunham, a general development of the relationship between the dipole moment of a compound and the absorption strength of its bands is deduced. It is shown that a determination of the moment in the case of homopolar binding can be made on the basis of measurements of total absorption in a series of overtones. The moment of the aliphatic CH-bond is estimated at $0{\cdot}3$ to $0{\cdot}4 \times 10^{-18}$. To the first approximation, the absorption strength of the CH-frequencies is proportional to the number of CH-bonds in the molecule. C. B. A.

696. Infra-Red Absorption Spectra of Photochemically Sensitised Alkali Halide Crystals. K. Korth. *Göttingen Nachrichten, Fachgruppe* 2. 1. 21. *pp.* 221–227, 1935.—The photochemical sensitisation of KCl and KI by addition of small amounts of KNO_3 or KCNO is concluded to arise from the formation of a complex, in which the essentially light-sensitive material is K_2O. W. R. A.

697. Infra-Red Absorption Spectra of Halogen Derivatives. J. Lecomte. *Comptes Rendus*, 201. *pp.* 1340–1342, *Dec.* 23, 1935. *In*

French.—Details are given of measurements in the region 1400 to 525 cm.$^{-1}$ of the absorption spectra of some 30 halogen derivatives of benzene, naphthalene and similar compounds. A. H.

***698. Infra-Red Absorption Spectra of Quartz and Fused Silica from 1 to 7·5μ. D. G. Drummond.** *Roy. Soc., Proc.* 153*A*. *pp.* 318–339, *Jan* 1, 1936.—A description is given of apparatus for the measurement of the near infra-red absorption spectra of solid sections. Indications are given of the accuracy attainable and of some of the precautions necessary to ensure this accuracy. Results are given, in graphical form, of absorption measurements on a wide range of thicknesses of fused silica and quartz (ordinary and extraordinary rays) between 1 and 7·5μ in the near infra-red. The methods of calculating absorption coefficients, κ, taking account of reflection corrections, are indicated and a section on the probable accuracy of κ is included. The absorption coefficients also are given in graphical form. AUTHOR.

699. Structure of the Rotation Bands D and E of CuCl. J. Terrien. *Comptes Rendus*, 201. *pp.* 1029–1030, *Nov.* 25, 1935.—The bands were strongly excited in a discharge tube with internal electrodes and photographed in the second order of a large concave grating. The bands are very complicated as each element has an isotope so that four molecules are in question. The bands occur at 4353·86 and 4333·19 Å respectively. Their full examination will require even greater dispersion. F. S.

700. Absorption Spectra of Sulphur Vapour. L. d'Or. *Comptes Rendus*, 201. *pp.* 1026–1029, *Nov.* 25, 1935.—Three spectra have been previously observed—(*a*) a band spectrum between 2475 and 3800 Å, due to S_2, (*b*) a structureless spectrum extending to 3500 Å, due to S_8 or S_6, and (*c*) a band spectrum without fine structure extending from 3600 to 4200 Å. The last is said by Graham to be due to S_8, by Dobbie and Fox to S_3, and by Rosen to S_2. Taking thermodynamic considerations into account, it is now concluded to be due to an intermediate molecule, S_4 or perhaps S_3. F. S.

701. Absorption Spectra of Metal Halides. K. Butkow. *Acta Physicochimica*, 3. 2–3. *pp.* 205–217 ; *Disc.*, 217–218, 1935. *In German.*—Results of previous investigations of the following are reviewed :—(*i*) Absorption spectra and dissociation energies of diatomic halides MX and ionisation potentials of M, where M = Na, K, Rb, Cs, Cu, Ag, Tl ; (*ii*) Melting points of triatomic halides MX_2 and ionisation potentials of M and M^+, where M = Be, Mg, Ca, Zn, Sr, Cd, Hg, Tl, Pb ; (*iii*) Absorption spectra and dissociation products of MX_2 in the states of crystal, aqueous solution, and ethyl alcohol solution, where M = Zn, Cd, Hg, Sn, Pb ; (*iv*) Melting points and dipole moments of tetratomic halides MX_3 and ionisation potentials of M, where M = P, As, Sb, Bi ; (*v*) Absorption spectra and dissociation energies and products of MX_3, where M = Sb, Bi ; (*vi*) Absorption spectra of tetratomic halides M_2X_2, namely Cu_2Cl_2, Au_2Cl_2, Tl_2F_2. New observations of the absorption spectrum of Au_2Cl_2 vapour are recorded, and the energies of excitation and dissociation are compared with those for Cu_2Cl_2. In the *Discussion* **J. Larionov** gives results of his observations of absorption spectra of Te_2Cl_2 and Te_2Br_2 vapours [see Abstracts 5030 and 5032 (1935)], and **A. Terenin** points out that many questions as to the processes involved cannot be answered unambiguously by absorption spectrum observations alone. W. J.

702. Absorption Spectrum of Copper Hydride. B. Grundström. *Zeits. f. Physik*, 98. 1–2. *pp.* 128–132, *Nov.* 30, 1935.—Further bands are

found in the absorption spectrum of CuH. Measurements now made of the band at λ2240 are compared with those of Stücklen [see Abstract 537 (1926)]. In particular, the absence of the K-branch in Stücklen's measurements is closely discussed. F. S.

703. Absorption Spectrum of Nitrogen Peroxide. M. Lambrey and J. Corbière. *Comptes Rendus*, 201. *pp.* 1334–1335, *Dec.* 23, 1935. —A study is made of the absorption spectrum of nitrogen peroxide between λ3200 and λ4200, for temperatures varying from 26° to 96° C. In each case the partial pressure of NO_2 and N_2O_4 is calculated and the absorption coefficients are determined. In the case of N_2O_4 there is a single band showing no fine structure, whereas NO_2 exhibits several bands each having a very complex structure. A. H.

704. Ultra-Violet Absorption of Ice. E. J. Cassel. *Roy. Soc., Proc.* 153*A*. *pp.* 534-541, *Feb.* 1, 1936.—The absorption of thin films of ice is measured in the extreme ultra-violet. The absorption band of ice is found to be shifted towards short waves, relatively to that of vapour by 0·6 to 0·7 eV. Further, the absorption of heavy and light ice is compared and a shift of the heavy ice absorption towards short waves found, amounting to about 1300 cm.$^{-1}$ (= 0·16 eV.)—*i.e.*, of the same order as was observed by Franck and Wood for water vapour. These results are discussed in the light of existing theories of the structure of ice and a tentative explanation is put forward. It is then shown that these results were compatible with measurements on the dispersion of light and heavy ice made elsewhere. AUTHOR.

705. Absorption Spectrum of Lead Oxide (PbO). H. G. Howell. *Roy. Soc., Proc.* 153*A*. *pp.* 683–698, *Feb.* 1, 1936.—The band spectrum of PbO is produced in absorption by using a carbon arc furnace. The spectrum stretches from 2600 to 6000 Å and contains five systems, of which three are found in emission. The vibrational constants of all the levels involved are as shown:—

Level	ν_e	ω_e	$\chi_e\omega_e$
F	35769·1	373·1	4·50
D	30198·7	530·5	2·92
C	24864·0	518·0	3·90
B	22284·9	498·0	2·20
A	19723	452·0	3·3
X	0	721·8	3·70

No evidence for the E system reported by Shawhan and Morgan is found. It is probable that the ground state dissociates into two excited atoms. The spectra of the related molecules PbS, PbO, SnS, SnO, GeS, and GeO show many similarities and in particular it is found that the vibration frequency varies from state to state in a similar manner with oxide and sulphide molecules. These regularities are used to predict the vibration frequency of the ground state of the molecule PbSe. AUTHOR.

706. Predissociation in a $^1\Pi$-Level of CO and Dissociation Energy of this Molecule. F. Brons. *Physica*, 2. *pp.* 1108–1113, *Dec.*, 1935. *In English.*—A rotational analysis of the bands 10 → 19, 10 → 20 and 10 → 21 of the fourth positive group of CO is given. From this analysis the rotational constants B and α are calculated and compared with those from other investigations. They show a good agreement. The height of the predissociation in the upper level A $^1\Pi$ (v = 10) is calculated and ascribed to the dissociation state ^{3}P (oxygen) + ^{1}D (carbon) of the

molecule, all the other possibilities being excluded. This makes the value of 8·41 volts for the dissociation energy of CO perfectly certain. AUTHOR.

707. Absorption Spectrum of Hydrogen. H. Beutler, A. Deubner and H. O. Jünger. *Zeits. f. Physik*, 98. 3–4. *pp.* 181–197, *Dec.* 14, 1935.—This paper deals with the arrangement of the state D in the term scheme of hydrogen, after the absorption spectra of H_2 and D_2 [see Abstract 4281 (1935)] have been determined. The (D ← A) bands in para-H_2 exhibit completely revolved rotation structure; in D_2, the revolution is limited to the higher rotation terms. Analysis of the vibration series, when the isotope rules are employed to a first approximation, give the empirical formulæ:

$H_2 : \nu_0 = 111849 + 2315\,(v^1 + \frac{1}{2}) - 59{\cdot}25\,(v^1 + \frac{1}{2})^2$; $v^1 = 3$ to 10.

$D_2 : \nu_0' = 112428 + 1652\,(v^1 + \frac{1}{2}) - 30{\cdot}5\,(v^1 + \frac{1}{2})^2$; $v^1 = 4$ to 11.

Richardson has proposed a similar formula based on Hopfield's observations. The state D is to be characterised by 3 $p\pi^1\,{}^1\Pi_u$ of H_2(or D_2), and the following edge formulæ are proposed:

$H_2 : \nu_v = 111859 + 2316{\cdot}0\,(v^1+\frac{1}{2}) - 60{,}75\,(v^1+\frac{1}{2})^2 + 0{\cdot}1667\,(v^1+\frac{1}{2})^3$.

$D_2 : \nu_v' = 112485 + 1638{\cdot}5\,(v^1+\frac{1}{2}) - 30{,}405\,(v^1+\frac{1}{2})^2 + 0{\cdot}0591\,(v^1+\frac{1}{2})^3$

and for $K^1 = 0$; ν_e (H_2) = 113973 cm.$^{-1}$; ν_e (D_2) = 114000 cm.$^{-1}$. These formulæ do not agree completely with the experimental data, while Richardson's emission terms fit badly into the analysis; reasons are discussed. H. H. Ho.

708. Barium Hydride Infra-Red Spectra. P. G. Koontz and W. W. Watson. *Phys. Rev.* 48. *pp.* 937–938, *Dec.* 15, 1935.—Quantum analysis of the (1,0), (1,1) and (2,1) bands of the infra-red $^2\Sigma \rightarrow {}^2\Sigma$ system of BaH and some details of the $^2\Pi \rightarrow {}^2\Sigma$ band at 10,300 Å are presented. The spin doubling constant γ of the upper $^2\Sigma$ state is very large ($-4{\cdot}88$) and decreases with increasing molecular rotation, $A \simeq 625$ cm.$^{-1}$ for the $^2\Pi$ state, and a perturbation occurs in the $^2\Pi_{\frac{1}{2}d}$ levels at $J = 11\frac{1}{2}$.

AUTHORS.

709. Band Spectra of BiBr, BiCl, BiF, and BiI in Absorption. F. Morgan. *Phys. Rev.* 49. *pp.* 41–46, *Jan.* 1, 1936.—The band spectra of BiBr, BiCl, BiF, and BiI are examined in absorption and a vibrational analysis is made for each of the observed systems. For BiBr there are two systems for each of the isotopes Br^{79} and Br^{81} with origins at 4045·7 Å and 4869·1 Å. The lower frequency system degrades to the red, but the direction in which the other degrades is in doubt. In BiCl a band system lying between 3600 and 4000 Å is found for each of the isotopes Cl^{35} and Cl^{37} in addition to the system at 4300–5500 Å reported by Saper. The vibrational analyses are confirmed by the respective isotope shifts. One band system between 4150 and 4900 Å for BiF and one between 4150 and 4300 Å for BiI have been observed and analysed.

AUTHOR.

710. Absorption Spectra of PbF, PbCl and PbBr. F. Morgan. *Phys. Rev.* 46. *pp.* 47–49, *Jan.* 1, 1936.—A vibrational analysis is made of absorption band systems due to PbF, PbCl, and PbBr. A single system of double-headed bands lying between 4100 and 5300 Å is observed for PbF. The separation of the heads is nearly constant. In PbCl a band system with the origin at 4571·8 Å is found for each of the isotopes Cl^{35} and Cl^{37}. Similarly a system of bands between 4400 and 5400 Å is observed for each of the isotopes Br^{79} and Br^{81}. The vibrational analyses are confirmed by the respective isotope shifts. All the bands degrade to the red. AUTHOR.

711. Band Spectrum of OH^+. F. W. Loomis and W. H. Brandt. *Phys. Rev.* 49. *pp.* 55–66, *Jan.* 1, 1936.—Two bands at 3332 and 3565 Å discovered by Rodebush and Wahl in the electrodeless discharge in pure water vapour, and two new bands at 3695 and 3893 Å, are shown to be, respectively, the (1,0), (0,0), (1,1) and (0,1) bands of OH^+. Rotational analysis establishes that they correspond to a $^3\Pi \rightarrow {}^3\Sigma^-$ transition in which the $^3\Pi$ state is inverted, with coupling intermediate between cases *a* and *b*. The nine strong branches to be expected in this type of transition are found, and also enough satellite branches (nine in the 0,0 band) to determine the multiplet intervals in both states. The Λ type doubling is large and there are exceptionally large perturbations in the 3*b*, 2*a* and 1*b* levels of the $v' = 1$ state, with maxima at approximately $K^1 = 18{\cdot}5$, $14{\cdot}5$ and $10{\cdot}5$ respectively. These perturbations are attributed to another $^3\Sigma^-$ state. The $^3\Sigma^-$ state concerned in the transition and the perturbing state are molecular levels which dissociate into the ground states of O and H^+ and O^+ and H, respectively, but one cannot tell which is which. The $^3\Pi$ state probably dissociates into the ground states of O and H^+. AUTHORS.

712. Band Spectra of Lead Halides. G. D. Rochester. *Roy. Soc., Proc.* 153*A*. *pp.* 407–421, *Jan.* 1, 1936.—An account is given of the emission band spectra of PbF and PbCl. Each spectrum is found to consist of one large system which includes all the observed bands except a few in the case of PbCl. The vibrational constants are as follows in $cm.^{-1}$:

	State	ν_e	ω_e	$\chi_e\omega_e$
PbF	A	22,566·6	397·75	1·77
	X	0	507·5	2·32
$PbCl^{35}$	A	21,863·3	228·8	0·795
	X	0	303·6	0·875

Popov and Neujmin's analysis of PbCl is shown to be incorrect. Many PbCl bands of small v'' value are observed in absorption also. No definite evidence of lead isotope effects is obtained, presumably because of insufficient resolving power; but large chlorine isotope effects are observed. Some discussion of the relation between the vibrational constants of certain heavy molecules is given. AUTHOR.

713. Absorption Spectra of the Vapours of the Monoxides and Monosulphides of Copper, Iron, Nickel and Cobalt and the Determination of their Heats of Sublimation. H. Trivedi. *Acad. Sci., Proc. U.P. India*, 5. *pp.* 27–40, *Sept.*, 1935.—A study of the absorption spectrum of the vapours shows only one region of continuous absorption for CuO and FeO, and two for NiO and CoO. The long wave-length limits are FeO, 2500; NiO, 3270 and 2380; CoO, 2750 and 2100; CuO, 2410Å. The difference between the limits of the two regions is about 32 k.cal. in each case; this may be due to the oxides dissociating into the metal atom and $O(^3P)$ and $O(^1D)$. The calculated heats of vaporisation for FeO, CoO, and NiO are $97{\cdot}5$, $101{\cdot}5$, and $111{\cdot}5$ k.cal., respectively. The vapours of the sulphides, studied in the region 7000–1900 Å, absorb light continuously from a long wave-length, resulting in a photochemical dissociation into two normal atoms, the reaction being: $MS + h\nu_1 = M + S(^3P)$. After the first absorption there is a retransmitted patch, and a second absorption corresponding to $MS + h\nu_2 = M + S(^1D)$. The heats of vaporisation are determined indirectly as FeS, 93; NiS, $101{\cdot}6$; CoS, 89; CuS, 84 k.cal. The difference $h\nu_1 - h\nu_2 = 1{\cdot}31$ volts is attributed to the difference $^3P - {}^1D$ of S. No bands characteristic of the compounds of the transition group are obtained. N. M. B.

714. Influence of Temperature on the Continuous Spectrum in the Neighbourhood of the Rayleigh Ray. E. Gross and M. Vuks. *J. de Physique et le Radium*, 6. *pp.* 457–461, *Nov.*, 1935.—The influence of temperature on the continuous spectrum in the neighbourhood of the Rayleigh ray is studied for diphenyl ether, xylene, and benzophenone. Elevation of temperature increases the intensity of the central portion of the continuous spectrum, but the outer parts are not affected. The results are interpreted on the basis of an interaction between incident light and thermal vibration (Debye's acoustic spectrum). W. R. A.

715. Raman Spectrum of Deuterium. Part II. S. Bhagavantam. *Indian Acad. Sci., Proc.* 2*A. pp.* 477–482, *Nov.*, 1935.—Measurements have been made of the intensity and polarisation of the lines in the Raman spectrum of D_2. The results when compared with those calculated from the theory of rotational Raman scattering due to Manneback, show satisfactory agreement. The vibration Raman line in D_2 is found to exhibit a depolarisation factor of 0·18 and an intensity of about one-tenth of the aggregate intensity of the rotational scattering. From this result it is estimated that the intensity of the vibration line is about 1/300 of that of the Rayleigh line. This is an unusually large ratio for gases and has hitherto been found only in H_2. Further work in relation to the fine structure of the vibration line and the inter-comparison of the P, Q and R branches is in progress. [For Part I, see Abstract 5051 (1935)]. AUTHOR.

716. Raman Spectra of CCl_4 and $SiCl_4$. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 2*A. pp.* 452–458, *Nov.*, 1935.—The Raman spectra of CCl_4 and $SiCl_4$ are examined with a dispersion of 10 Å/mm. as well as with a lower dispersion instrument. A faint line is found at 434 cm.$^{-1}$ which is attributed to 2 × 217 cm.$^{-1}$, and is thought to come out with reasonable intensity because of its coupling with 459 cm.$^{-1}$. A line of similar origin is found at 440 cm.$^{-1}$ in $SiCl_4$. An additional faint line is found in CCl_4 at 145 cm.$^{-1}$ attributed to the difference between the fundamentals at 459 and 314 cm.$^{-1}$. The 459 cm.$^{-1}$ line in CCl_4 shows a well defined wing on the red side. A. C. M.

717. Raman Spectra of Amino-Acids and Related Compounds. Part I. Ionisation of Carboxyl Group. J. T. Edsall. *J. Chem. Phys.* 4. *pp.* 1–8, *Jan.*, 1936.—Raman spectra are determined for four amino acids and their hydrochlorides ; for three fatty acids and chloracetic acid, and their sodium salts ; and for several related compounds. The influence of solvent water in the Raman spectra of aqueous solutions is discussed. The CO frequency at 1670 cm.$^{-1}$ in pure fatty acids is shifted to 1720 cm.$^{-1}$ when they are dissolved in water. No shift is found for methyl acetate or acetone. On ionisation of the COOH group it is found that (1) the " carbonyl " frequency vanishes, (2) a group of lines in the region 1200–1420 cm.$^{-1}$ undergo changes in position and intensity ; (3) in most cases a powerful line about 750–930 cm.$^{-1}$ changes in frequency about 20–40 cm.$^{-1}$ on ionisation, and (4) ionisation markedly increases the C-H frequency in methyl and ethyl amine. A. C. M.

***718. Source for the Balmer Series of Hydrogen and Deuterium. G. P. Harnwell.** *Am. Phys. Teacher*, 3. *pp.* 185–188, *Dec.*, 1935.—The manufacture and operation of an electrodeless discharge source of the hydrogen Balmer series is described. The construction of a suitable driving oscillator is also indicated. Methods of use for photographing 12 to 15 members of the series and for measuring their wave-lengths and

the wave-length differences between the hydrogen and deuterium lines are given. Illustrative results are included. AUTHOR.

*719. **Large-Aperture Spectrograph for the Ultra-Violet. A. Arnulf and B. Lyot.** *Comptes Rendus*, 201. *pp.* 1480–1482, *Dec.* 30, 1935.—To obtain an aperture of F/1, the camera objective is replaced by a mirror. Correction for spherical abervation can be made by a plane-parallel plate, suitably deformed on one face, or by two lenses over-corrected for apertures less than 10 cm. These can be the collimator lenses if there is a collimator. A quartz instrument has been made with Cornu prism, collimator 500 mm. f. and 50 mm. dia. mirror of 100 mm. radius aluminised. Radius of curvature of image is 50 mm. and inclination of plate about 15°. It gave 8 mm. spectrum from 2300 to 6500Å and 2·5 mm. between 3000 and 5500 Å. The night sky spectrum has been photographed to 3022 Å in 5 hours. F. S.

720. **Spectrographic Study of Structure of Alloys. H. Triché.** *Comptes Rendus*, 201. *pp.* 1178–1181, *Dec.* 9, 1935.—In alloys of Al-Cr and Al-Fe there are crystals containing more Fe or Cr than the remainder of the alloy. These may be exposed by etching, the remainder protected and the spectrum of the crystals excited by h.f. (Tesla) discharge. Quantitative determination with a rotating sector led to a value of Cr : Al of 18·2 % Cr. Fink and Freche have obtained chemically the formula Al_7Cr_1, giving 21·4 % of Cr. F. S.

721. **Quantitative Spectral Analysis. Part IV. R. Breckpot and A. Mevis.** *Ann. Soc. Sci. de Bruxelles*, 55. *pp.* 226–292, *Dec.* 27, 1935.—Work previously reported [see Abstract 2594 (1935)] is continued for Ti, V, Cr, Mn, Co, Ni, Mo, and In. Results for these metals are tabulated and discussed. N. M. B.

See also Abstracts 371, 372, 494, 535, 622, 647, 663, 664, 669, 763, 802, 806, 810, 854.

VISION.

722. **Theories of Vision. F. W. Edridge-Green.** *Nature*, 136. *pp.* 765–766, *Nov.* 9, 1935.—The visual purple theory that only the cones are percipient elements the function of the rods being to regulate the supply of visual purple in the medium surrounding the cones, is compared with the duplicity theory of vision. Explanations of the experimental facts usually given as supporting the duplicity theory (absence of Purkinje effect at fovea, two branch form of Porter graphs, etc.) are obtained in terms of the visual purple theory. Several phenomena are described which, it is claimed, can be accounted for only by the visual purple theory (drift of after-images, bending of the recurrent image at the fovea, etc.). W. S. S.

*723. **Light-Sensitive Systems. J. Eggert.** *Phot. J.* 76. *pp.* 17–26, *Jan.*, 1936.—Gives a brief review of the most important of the light-sensitive systems comparing them particularly with the human eye, and examining the practical aspects of the conclusions reached in the comparisons. The systems considered are the sensitive emulsions as used in photography, light-sensitive cells, and the human eye, it being concluded that the other light-sensitive systems reach the eye-sensitivity at least in part and are, in fact, greatly superior to the eye if the accumulated effect be taken into account. In spectral sensitivity the other systems are

greatly superior in range to the eye, but the perception of small colour differences finds the eye unexcelled. R. C. F.

See also Abstracts 567, 604.

X-RAYS.

724. Simplified Deduction of the Klein-Nishina Formula. G. Wannier. *Helv. Phys. Acta*, 8. 8. *pp.* 665–673, 1935.—A simplified deduction of the scattering formula of Klein and Nishina is given. Since the deduction of the formula from Dirac's radiation theory the methods in this region have been simplified, but no clear deduction is to be found. The supply of this vacancy is the object of this paper. J. J. S.

725. Absorption of Short Wave-Length X-Rays. W. V. Mayneord and J. E. Roberts. *Nature*, 136. *pp.* 793–794, *Nov.* 16, 1935. —Absorption coefficients for nearly monochromatic X-rays of mean wave-length 59 X.U. have been measured in a series of 18 elements from Li to Pb. The mean absorption per electron for light elements up to Ca is in good agreement with the predictions of the Klein-Nishina formula. The photo-electric absorption per electron follows the law $\tau_e = kZ^{3\cdot0}$. Measurements have also been made in water, ethyl alcohol and D_2O, showing that D_2, owing to its normal electron density, is, from the point of view of X-ray absorption, a normal light element. J. E. R.

726. Electron Terms in Ionic Lattices. R. de L. Kronig. *Zeits. f. techn. Physik*, 16. 11. *pp.* 335–338, 1935. *Phys. Zeits.* 36. *pp.* 729–732, *Dec.* 1, 1935.—The origin of the fine structure of X-ray absorption edges is considered. The influence of various factors is tested experimentally and it is emphasised that in order to determine electron levels in ionic lattices, from measurements of fine-structure, a more accurate theoretical knowledge of the wave function is necessary. Further experiments with soft and very soft X-rays are essential. J. T.

727. Relativistic Theory of the Auger Effect. H. S. W. Massey and E. H. S. Burhop. *Roy. Soc., Proc.* 153*A*. *pp.* 661–682, *Feb.* 1, 1936.—The Auger transition probabilities of the type $L_I\,L_I \rightarrow K, \infty$, $L_I\,L_{II} \rightarrow K, \infty$, $L_I\,L_{III} \rightarrow L, \infty$, have been calculated for gold (79), using Dirac wave functions and Møller's method for the relativistic treatment of two-electron problems. The results are compared with those obtained in a non-relativistic calculation. It is found that relativity increases the K series internal conversion coefficient for gold by a factor of two, and gives for the relative importance of the above three transitions the ratio $1 : 5\cdot5 : 5\cdot3$ in contrast with the non-relativistic ratio $1 : 1\cdot14 : 2\cdot28$. A few calculations have also be made for silver (47) and it is found that here, too, relativistic effects are appreciable, though much less so than for gold. The importance of carrying out experiments to test these conclusions, and the light that would thus be thrown on the validity of the Dirac theory of the electron are stressed. The established features of the Auger effect are explained quantitatively in a satisfactory way by the wave mechanical theory. AUTHORS.

728. Structure of the Latent X-Ray Image. W. Hofmann. *Zeits. f. wiss. Phot.* 34. *pp.* 267–275, *Nov., and pp.* 277–292, *Dec.*, 1935.—Describes the results of an examination made in order to determine the manner in which the action of X-rays on AgBr gelatin layers differs from that of light. The latent X-ray image is differently distributed from the latent light image, not only within the layer, but also within individual

AgBr grains, and it is improbable that there is a mechanical dispersion of the AgBr by X-rays. Two latent X-ray images are produced, one —R I—consisting of Ag nuclei of a definite size and capable of being developed, the other—R II—consisting of very small nuclei or "ultra-nuclei." This latter latent image if illuminated with normal light gives rise not only to normal compact nuclei, but also to light sensitive nuclei in a finely divided form which produce a latent light image, L II. The latent image R II cannot be chemically developed as the ultra nuclei coagulate with the normal light and X-ray nuclei. Primary physical development yields a substance similar to the latent image L II, but primary fixing dissolves the material of the image R II. The image L II is also not capable of development by chemical or primary physical methods because of coagulation but short primary fixing activates a nucleus material which is capable of development by a secondary process. This developable property is, however, lost if the time of fixing is long. Finally, these results are used in an endeavour to explain the "light development" of the X-ray image, the Villard effect, and the sensitivity increase due to X-rays with secondary development. R. C. F.

729. Theory of the Effect of Temperature on the Reflection of X-Rays by Crystals. Part I. Isotropic Crystals. C. Zener and G. E. M. Jauncey. *Phys. Rev.* 49. *pp.* 17–18, *Jan.* 1, 1936.—A short derivation of the Debye-Waller temperature factor in the reflection of X-rays from isotropic crystals is given. This short derivation clearly brings out the assumptions involved and paves the way for the extension of the theory to the more complex case of anisotropic crystals. One of the authors will give this extension in a subsequent paper. AUTHORS.

730. Natural Breadth of X-Ray Lines. G. Ortner and R. Zentner. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 7–8. *pp.* 438–453, 1935.—The problem is considered, of eliminating errors due to slits and to the reflecting crystal, in the measurement of the breadth of X-ray spectral lines. The K-series of Fe, Co, Ni and Cu are investigated, the reflecting crystal being calcite. A method is given, based on Prins' function for the intensity distribution of reflected X-rays, for obtaining the true half-value breadth of a spectral line. J. T.

731. Excitation of the K-Radiation of Nitrogen, Oxygen and Neon by α-Particles. W. Riezler. *Ann. d. Physik*, 24. 8. *pp.* 714–718, *Dec.*, 1935.—The excitation function for the K-radiation of N, O and Ne by α-particles in dependence on the range of the exciting particles is investigated throughout an extent of range of 13–35 mm. air equivalent. It is found that the curves have a course analogous to Bragg curves for the total ionisation by α-particles in air; which is in agreement with earlier investigations by Bothe and Fränz. For N the excitation curve attains at about 30 mm. range a flat maximum. The maximum for O is situated at about 35 mm. range. The Ne curve does not reach a maximum in the region of measurement; it indicates however that the excitation function has a point of inflection at an α-particle range of 13 mm. J. J. S.

732. K-Spectra of Molybdenum and Rhodium. H. Hulubei. *Comptes Rendus*, 201. *pp.* 1356–1359, *Dec.* 23, 1935.—A large spectrograph using either curved mica sheet or quartz gives the large dispersion of 1 X.U. per mm. Many new Kβ-lines have thus been obtained, or new resolution obtained, which allow further light to be thrown on the possible structure of the K-levels of Mo and Rh. J. E.

733. K-Spectrum of Copper. Yvette Cauchois. *Comptes Rendus*, 201. *pp.* 1359–1361, *Dec.* 23, 1935.—Using dispersion of the order 4·7 X.U. per mm., the author has been able to resolve the complexities of the β_4- and β_5-lines of Cu, besides resolving many other β-lines. A table of results is given showing the new lines and the comparison of known lines with the results of previous observers. J. E.

734. Probability of KL Ionisation and X-Ray Satellites. R. D. Richtmyer. *Phys. Rev.* 49. *pp.* 1–8, *Jan.* 1, 1936.—A theory of the multiple ionisations produced by a fast kathode electron in the target of an X-ray tube is developed, based on the Born approximation of collision theory. The effective cross-section for 1*s*2*s* ionisation of potassium by an incident electron having five times the energy required for K-ionisation or 1*s*-ionisation of potassium, and the distribution of energy and of angular momentum among the three electrons after collision is shown in detail. The probability of 1*s*2*p* ionisation is also estimated roughly by the same method, and the two taken together are shown to be roughly in agreement with the experimental value of the integrated satellite intensity for Kα of potassium. The predicted variation of the relative intensity with atomic number is also shown to be in rough agreement with experiment. AUTHOR.

735. Effects of Chemical Binding on the X-Ray K$\alpha_{1,2}$ Doublet Lines of Sulphur. L. G. Parratt. *Phys. Rev.* 49. *pp.* 14–16, *Jan.* 1, 1936.—Ionisation curves of the K$\alpha_{1,2}$ doublet lines of S are recorded with the two-crystal spectrometer. Several sulphides and sulphates are used as targets. The effects of the chemical binding on the wave-length, on the $\alpha_1 \rightarrow \alpha_2$ separation and on the doublet contour are measured. With suitably chosen targets, the wave-length shift of the SK$\alpha_{1,2}$ lines from sulphates to sulphides is observed in the process of shifting. AUTHOR.

736. Dynamical Theory of X-Ray Diffraction. M. Kohler. *Preuss. Akad. Wiss. Berlin, Ber.* 19. *pp.* 334–338, 1935.—The question of the diffraction of X-rays by crystals is treated mathematically, the subject being approached from the point of view of wave-mechanics. J. T.

737. Calculation of the Intensity of the Interference Lines in Debye X-Ray Photographs. N. Zelljakoff, A. Stefanowsky and J. Hurgin. *Zeits. f. Physik*, 98. 1–2. *pp.* 66–71, *Nov.* 30, 1935.—It is shown that the theory for the calculation of the line intensity in Debye X-ray photographs needs an important supplement. A new factor is introduced into the basic formula, *viz.*, the dependence of the intensity on the breadth of the pencil which takes part in the reflection under the given angle. J. J. S.

738. Rôle of Slit in Distribution of Intensities in an X-Ray Powder Photograph. A. Rogozinski. *Comptes Rendus*, 201. *pp.* 1354–1356, *Dec.* 23, 1935.—Considers the effect of the slit width on the position of the maximum. A finite width shifts the maximum for the theoretical Bragg position for an infinitesimal width of beam. For if a finite width of specimen is irradiated the reflected spot is diffused by the multiplicity of point sources in the specimen. It is shown that this broadening is not symmetrical since the view of the specimen from any diffracted position is not symmetrical. The error expressed in grating space is $\Delta d/d = 1/$ $\cot\phi \cos^2 2\phi \cdot e/D$, where e is half width of specimen and D is distance from plate to specimen. J. I.

739. Single-Crystal Anti-Kathode. H. Seemann. *Zeits. f. techn. Physik*, 16. 11. *pp.* 443–447, 1935. *Phys. Zeits.* 36. *pp.* 837–841, *Dec.* 1, 1935.—The photographs obtained by the use of a single-crystal anti-kathode are made much clearer by cutting out the trace of the direct beam. This is done by a back-reflection method. J. T.

***740. Two-Crystal X-Ray Spectrometer for Wave-Lengths 0·030 to 0·215Å. T. R. Cuykendall and M. T. Jones.** *Rev. Sci. Instruments*, 6. *pp.* 356–361, *Nov.*, 1935.—A two-crystal X-ray spectrometer for use in the wave-length region $0{\cdot}030 < \lambda < 0{\cdot}215$ Å is described. Transmission and reflection of the X-rays through the body of the crystal, instead of the usual reflection from the surface, is employed. An ionisation chamber containing argon at 80 atmospheres, and an FP-54 electrometer tube system is used to measure the intensity of the reflected radiation. A source of short wave-length X-rays, consisting of two specially designed induction coils and a cascade Coolidge tube, is described. Rocking curves in the (1, — 1) position at 50 X.U., the K limits of lead and of uranium, and the Kα and Kβ-lines of tungsten are observed for the purpose of calibrating the spectrometer. The resolving power of the instrument with the present crystals is discussed. AUTHORS.

***741. Resolving Power of the Two-Crystal X-Ray Spectrometer. L. G. Parratt.** *Rev. Sci. Instruments*, 6. *pp.* 387–399, *Dec.*, 1935.—An experimental study of the physical meaning of resolving power when the shape of the diffraction pattern is unknown. The widths and shapes of the Kα doublets of Mo, Cu, Ti and Ag Lα, have been measured with the spectrometer in various parallel and antiparallel positions. The diffraction patterns are found to be asymmetrical in agreement with theory, the asymmetry varying with different pairs of crystals and with wave-length. New criteria for " spectrometric " perfection of calcite crystals are proposed and an equation is given for correcting observed line widths for the effects of " spectrometrically " perfect crystals. C. J. B. C.

See also Abstracts 417, 423, 599, 890, 903.

HEAT.

CALORIMETRY.

742. Heat Capacity of Gadolinium Sulphate from 1·0 to 20·5° K. C. W. Clark and W. H. Keesom. *K. Onnes Lab., Leiden, Comm. No.* 240*a*. *Physica*, 2. *pp.* 1075–1079, *Dec.*, 1935. *In English.*—The heat capacity of $Gd_2(SO_4)_3 \cdot 8\,H_2O$ is measured from 1·0 to 20·5° K. Its anomalous thermal behaviour, expected from theoretical considerations and first demonstrated by Kürti in the liquid helium range down to 1·6° K., is further verified down to 1° K. AUTHORS.

743. Temperature Dependence of Free Electron Specific Heat. E. C. Stoner. *Phil. Mag.* 21. *pp.* 145–160, *Jan.*, 1936.—Previous results for free electrons show that at the low temperature limit the specific heat is proportional to the temperature, at the high temperature limit constant. Results are obtained in this paper for the variation of the energy, E, and the specific heat, C_v, over the whole temperature range. Further terms are obtained in the series valid for $kT/\epsilon_0 > 1$ and $kT/\epsilon_0 < < 1$, where ϵ_0 is the maximum electron energy in the completely degenerate state; and estimates are made of the range of values of kT/ϵ_0 for which a limited number of terms in these series may be used to give good approximations. The temperature variation of E and C_v is shown in diagrams and a table of numerical results is given. The conditions under which the results may be applied to electrons in metals are indicated. AUTHOR.

744. Heat Capacity Data for Organic Glasses. Entropy and Free Energy of *dl*-Lactic Acid. G. S. Parks, S. B. Thomas and D. W. Light. *J. Chem. Phys.* 4. *pp.* 64–69, *Jan.*, 1936.—Heat capacity measurements by the Nernst method are made upon samples of secondary butyl alcohol and 3-methylhexane in the glassy and liquid condition and upon a sample of *dl*-lactic acid (1) in an incompletely crystallised state; (2) in the form of an *acid* glass and liquid, and (3) in the form of a *mixed* glass and liquid. From these results the specific heats and heat of fusion of pure crystalline *dl*-lactic acid also are derived. The data for the several glasses and undercooled liquids show a rapid rise from the heat capacity characteristic of a crystalline solid to that for the liquid state within a transition region of about 10° and the nature of this transition region is discussed. A calculation of the molal entropy and free energy of formation of liquid *dl*-lactic acid at 298·1° K. yields 45·9 (± 1·0) e.u. and −124,300 ± (2300) cal., respectively. AUTHORS.

745. Glass Formation by a Hydrocarbon Polymer. J. D. Ferry and G. S. Parks. *J. Chem. Phys.* 4. *pp.* 70–75, *Jan.*, 1936.—Polyisobutylene, with an average molecular weight of about 4900, is at room-temperature a highly viscous liquid. When cooled, it has been found to form a glass, with the same transitions in thermal properties characteristic of the vitrification of substances of low molecular weight. The heat capacity of polyisobutylene is measured from 118° K. to 295° K. It increases by 32 % between 192° K. and 202° K. The thermal expansion coefficient of polyisobutylene is measured from 160° K. to 300° K. It increases by 200 % between 185° K. and 205° K. The mean temperature of transition corresponds to a viscosity of about 10^{13} poises, in agreement

with a rule observed generally for glass-forming materials. The factors on which the transition temperature depends are discussed. AUTHORS.

See also Abstract 762.

CONDUCTION.

746. Temperature-Rise in a Material of which the Thermal Properties Vary with Temperature. J. H. Awbery. *Phys. Soc., Proc.* 48. *pp.* 118–123; *Disc.*, 123–124, *Jan.* 1, 1936.—The partial differential equations governing the flow of heat in a medium for which the thermal conductivity and volumetric specific heat vary parabolically with temperature is reduced to an ordinary differential equation for the case when the medium is semi-infinite in extent. The equation is solved exactly for the case where the two properties vary proportionally to each other, and approximately, in powers of $x/\sqrt{(2t)}$, where x is the distance from the hot face and t the time, for the general case. AUTHOR.

See also Abstracts 553, 833.

CONVECTION.

747. Insufficiency of the Heat Equation for a Problem in Convection. P. Vernotte. *Comptes Rendus*, 201. *pp.* 1102–1104, *Dec.* 2, 1935.—A case of forced convection is considered in which the classical equation of heat flow fails to give a determinate solution owing to the second derivative of temperature being discontinuous. It is shown that the indeterminate terms disappear and a solution can be reached if, in addition, the finite heat flux from a finite area of the surface be considered. R. W. P.

See also Abstracts 541, 553.

DILATATION.

***748. Coefficient of Expansion of Silver Iodide and of the Halides of Thallium. G. Jones and F. C. Jelen.** *Am. Chem. Soc., J.* 57. *pp.* 2532–2536, *Dec.*, 1935.—A new form of differential weight dilatometer for the determination of the cubical coefficient of expansion of solids and liquids is described. The instrument functions simultaneously as a thermostat regulator and controls its own temperature so that it is exactly filled. Measurements are made on six substances between 20 and 60°, giving the following mean cubical coefficients of expansion: pyrex glass, $9{\cdot}8_5 \times 10^{-6}$; toluene, $1{\cdot}111 \times 10^{-3}$; silver iodide, $-1{\cdot}_6 \times 10^{-6}$; thallous chloride, $1{\cdot}59 \times 10^{-4}$; thallous bromide, $1{\cdot}53 \times 10^{-4}$; thallous iodide, $1{\cdot}35 \times 10^{-4}$. AUTHORS.

749. Dilatation of Para-Azoxyphenetole and the Nature of the Phase-Change, Mesomorphic State-Isotropic Liquid. E. Bauer and J. Bernamont. *J. de Physique et le Radium*, 7. *pp.* 19–22, *Jan.*, 1936.—Two kinds of phase change may be distinguished, characterised on the one hand by a latent heat, a discontinuity of volume and the Curie points, and on the other by no abrupt variation of internal energy or of volume, but by discontinuities in the derivatives of these quantities with respect to temperature or pressure, *i.e.*, specific heat, dilatation coefficient and compressibility. Exact measurements with the nematic mesomorphic substance, para-azoxyphenetole, indicate that at the point of clarification there is a true change of phase, and that this is

accompanied by a definite volume discontinuity. The paper contains data for the dilatation coefficients at different temperatures and for the volume discontinuity at the clarification point, together with full experimental details of the measurements. H. H. Ho.

MELTING AND BOILING POINTS.

750. Boiling Points of Normal Paraffin Series. E. R. Cox. *Indust. and Engin. Chem.* 27. *pp.* 1423–1425, *Dec.*, 1935.—Methane and ethane are found not to be true homologues of the series with reference to boiling points, which latter can be verified only by experiment, but, if these substances be treated as separate problems, the remainder of the normal paraffin series can be reconciled by a simple formula between the logarithm of the boiling point and the logarithm of the molecular weight, viz., $\log_{10}T_B$ (°K.) $= 1{\cdot}07575 + 0{\cdot}949128 \log_{10}m - 0{\cdot}101 \log_{10}{}^2m$. Taking the best observed values from propane to octane, excepting butane, the agreement is perfect. Since Shepard's observed points for undecane and dodecane could not possibly be correlated with the points from propane to octane, it seems conclusive that deviations from the above equation indicate decomposition (confirmed experimentally by Shepard) and that the plausibility of the curve of deviations substantially verifies the equation up to $C_{20}H_{42}$. H. H. Ho.

751. Melting Points of Eutectics: Lipowitz Alloy and Wood's Metal. S. J. French. *Indust. & Engin. Chem.* 28. *pp.* 111–113, *Jan.*, 1936.—Much confusion exists concerning both composition and melting points of the so-called Lipowitz alloy and Wood's metal. Although they differ slightly in composition, these alloys have the same melting-freezing range (69·7° to 71·7° C.). The alloy of composition 50 % Bi, 27 Pb, 13 Sn, 10 Cd, approaches the eutectic composition more closely than does the alloy composed of 50 % Bi, 25 Pb, 12·5 Sn, 12·5 Cd. Many of the abnormally low points reported in the literature may be those of undercooled alloys or amalgams. Confusion can best be eliminated by dropping both names, calling the eutectic alloy simply a quaternary eutectic, and stating its composition and melting-freezing range. AUTHOR.

752. Orthobaric Azeotropes, Esters-Hydrocarbons. M. Lecat. *Ann. Soc. Sci. de Bruxelles*, 55. *pp.* 253–265, *Dec.* 27, 1935.—Results are given for 315 systems of 44 hydrocarbons and 72 esters. There are 147 definite instances of azeotropism and 168 of zeotropism or of unconfirmed azeotropism. Tabular data are given, for each hydrocarbon with various esters, of the boiling points at normal pressure of the esters and of the azeotropes, the concentration of the latter, the thermal effect of mixing, and the Bancroft point, or intersection of the vapour pressure curves of the two constituents of the system. Regularities are much less marked than for cases in which one constituent is an amide or a compound containing an OH group. For such systems molecular association is much stronger in one constituent than in the other. N. M. B.

753. Relative Rates of Evaporation of Different Liquids in Moving Air. S. I. Skljarenko and M. K. Baranajew. *Zeits. f. phys. Chem.* 175. *Abt.A.* 3. *pp.* 195–202, 1935.—It is shown theoretically that under similar conditions the relative rates of evaporation of two liquids in mol. sec. are given by $W_1/W_2 = P_1/P_2\{D_1\,(B-P_2/2)/D_2\,(B-P_1/2)\}^{\frac{1}{2}}$ where B is the barometric pressure, P_1 and P_2 the vapour pressures, and

D_1 and D_2 the diffusion coefficients of the liquids. This is verified by experiments on ethyl alcohol, methyl alcohol, propyl alcohol, benzene, ethyl acetate and toluol. R. W. P.

754. Azeotropic and Constant Evaporating Mixtures. S. I. Skljarenko and M. K. Baranajew. *Zeits. f. phys. Chem.* 175. *Abt.A* .3. *pp.* 203–213, 1935.—In order that a mixture shall retain a constant composition during evaporation it is shown that the following equation must be satisfied, $x_1/x_2 = p_1/p_2\ (D_1/D_2)^{\frac{1}{2}}$, where x_1 and x_2 are the mole-fractions of the components; p_1 and p_2 their partial vapour pressures, and D_1 and D_2 the diffusion coefficients of their vapours. This is verified by experiments using mixtures of ethyl alcohol and ethyl acetate, and of water and ethyl alcohol, propyl alcohol and formic acid. It is pointed out that azeotropic mixtures (mixtures which boil without change in composition) do not necessarily evaporate without change in composition, in fact, for the composition to remain constant in both cases it is necessary for $(D_1/D_2)^{\frac{1}{2}}$ to be approximately unity. R. W. P.

755. Dependence of Rate of Evaporation on Nature of Ambient Gas. S. I. Skljarenko and M. K. Baranajew. *Zeits. f. phys. Chem.* 175. *Abt.A.* 3. *pp.* 214–218, 1935.—The rates at which methyl alcohol, ethyl alcohol and benzene evaporate into streams of air, H_2 and CO_2 are determined. For those cases in which the vapour has a greater density than the gas above the liquid the results satisfy the relation $w_1/w_0 = (D_1/D_0)^{\frac{1}{2}}$, where w_1 and w_0 are the rates of evaporation of the substance in mol. per sec. into two gases having equal velocities, and D_1 and D_0 are the diffusion coefficients of the vapour into these gases. The influence of convection causes some departure from this relation when the vapour is lighter than the gas. R. W. P.

***756. Method of Making Extremely Thin Films. K. Lark-Horovitz, J. D. Howe and E. M. Purcell.** *Rev. Sci. Instruments*, 6. *pp.* 401–403, *Dec.*, 1935.—A method for making extremely thin films is developed for general use. A hole or slit in a metal plate is filled with a volatile solid and the surface is polished flat. This plate is clamped to the lower end of a liquid air container which extends into a high vacuum chamber. The material to be deposited is evaporated and covers slit and plate with a continuous film of desired thickness. The slit is then placed into the apparatus for the investigation of the film, and on evacuation the volatile material evaporates leaving the thin film supported on the slit. Camphor and naphthalene are used as volatile material. For investigations in which residues of organic substances have to be avoided ammonium chloride, which may be driven off in vacuum at about 220° C, can be used to support the film. AUTHORS.

See also Abstracts 388, 418, 492, 589, 590.

TEMPERATURE, MEASUREMENT OF.

***757. Spiral Bimetallic Thermometers. W. Grundmann.** *Zeits. f. Instrumentenk.* 56. *pp.* 26–31, *Jan.*, 1936.—Thermometers composed of bimetallic strips in the form of an archimedean spiral, in which the temperature is indicated by a pointer moving round a dial, have been described [see Abstract 2635 (1935)]. The author now describes further investigations into the performance of this type of instrument, and concludes that the deflection is greater than that of a simple bimetallic ring of the same heat capacity, but that the restoring force is less for the same

deflection. The calibration is somewhat altered by shaking and also depends to some extent on the inclination of the instrument. The effect of temperature changes is studied, annealing at low temperatures (−60° C.), producing a lasting decrease in the deflection. When enclosed in its case the response of the instrument is much slower than when unscreened. Possible improvements are suggested and it is concluded that a thermometer of this type can be developed into a useful instrument. R. W. P.

***758. Platinum Thermometers and Their Basic Points. W. H. Keesom and B. G. Dammers.** *K. Onnes Lab., Leiden, Comm. No.* 239*d*. *Physica*, 2. *pp.* 1051–1058, *Dec.*, 1935. *In English.*—Details of the construction of a set of platinum thermometers for temperatures down to − 190° C. are given. The optimum annealing temperature lies at 840 to 850° C. The basic points: ice-point, steam-point, sulphur-point, and oxygen-point, are determined. The latter is accepted as $-182{\cdot}98^{3\circ}$ C., in harmony with a new determination. [See following Abstract.]

AUTHORS.

***759. Comparison of Platinum and Helium Thermometers between 0 and − 183° C. W. H. Keesom and B. G. Dammers.** *K. Onnes Lab., Leiden, Comm. No.* 239*e*. *Physica*, 2. *pp.* 1080–1091, *Dec.*, 1935. *In English.*—Five platinum thermometers [see preceding Abstract] satisfying the conditions stipulated in the definition of the international temperature scale are compared with the helium thermometer between 0 and − 183° C. A cryostat is described giving a temperature constant and uniform within 0·002 degree. The readings of three of the thermometers (two of wire from Heraeus, one of wire obtained from the Bureau of Standards) agree within 0·003 degree. The fourth thermometer, made from wire furnished by Johnson and Matthey, and not compared directly with the others, agrees with those mentioned within reading errors of the helium thermometer. The fifth thermometer, from Heraeus wire, gives readings which differ 0·03 degree at − 138° C. from those of the first-mentioned set. The international temperature scale lies for temperatures between 0 and − 100° C. below the thermodynamic scale, to an amount of about 0·04 degree at − 80° C. Between − 120 and − 183° C. the international temperature scale lies above the thermodynamic scale. Maximum deviation between − 130 and − 140° C. Amount of the deviation as shown by the four first mentioned thermometers 0·01 to 0·02 degree. AUTHORS.

***760. Precision Thermostat for Use Down to − 20° C. G. A. Benford.** *Journ. Sci. Instruments*, 13. *pp.* 4–6, *Jan.*, 1936.—The construction of a precision thermostat incorporating a commercial refrigerator unit is described. The apparatus has been operated at 0° and − 5° with a maximum temperature variation of 0·002° C. and it would operate down to − 20° with great accuracy. AUTHOR.

THERMOCHEMISTRY.

761. Heats of Solution of Ferric Chloride in Water and Hydrochloric Acid. W. Kangro and R. Flügge. *Zeits. f. phys. Chem.* 175. *Abt. A.* 3. *pp.* 187–194, 1935.—The heats of solution of anhydrous $FeCl_3$ in water and in HCl are determined. The differential heats of solution and dilution in concentrated solutions are measured at 20° C. The heat of solution in HCl decreases rapidly as the concentration of the acid increases.

It is possible to calculate the heat of solution in HCl from the heat of solution in pure water and the diminished activity of the water up to a concentration of 10 % with great accuracy. In more concentrated solutions the results show considerable deviation from the calculated values, and the deviation is considered to be due to association. F. J. B.

***762. Heats of Solution and Specific Heats of Rhombic Sulphur in Carbon Disulphide : Surface Energy of Solid Rhombic Sulphur. A. R. Williams, F. M. G. Johnson and O. Maass.** *Canad. J. of Research*, 13. *Sect. B. pp.* 280–288, *Nov.*, 1935.—The heats of solution of rhombic S in CS_2 are measured over the concentration range 6 to 17 % of S and at 20° and 25° C., and the specific heats of these solutions are calculated. The apparatus designed for these measurements is described. By measuring the heat of solution of finely divided S and its particle size, the surface energy of solid rhombic S is estimated. AUTHORS.

763. Dissociation Energy of CO. D. Coster and F. Brons. *K. Akad. Amsterdam, Proc.* 38. 9. *pp.* 961–964, 1935.—An energy level diagram is given and available evidence is reviewed. During an investigation of the rotational structure of the fourth positive group a sudden disappearance of the lines which combine with the vibrational level $v' = 10$ of the upper level $A^1\Pi$ was found at 9·67 V above the $X^1\Sigma$ state of the molecule, giving a difference 1·41 V from the energy of predissociation in the Ångström bands, in exact agreement with the energy difference between the ^1S–^1D states of the C atom. This confirms the level diagram and gives 8·41 volts or 193·9 k.cal./mol. for the dissociation energy of CO. Hence the calculated heat of sublimation of solid carbon is 107·6 k.cal./mol. N. M. B.

764. Thermochemical Properties of Nitrous Oxide. T. Carlton-Sutton, H. R. Ambler and G. W. Williams. *Phys. Soc., Proc.* 48. *pp.* 189–202, *Jan.* 1, 1935.—With a view to determining the heat of formation of N_2O by means of a direct decomposition into its elements, the conditions of initiation and of pressure under which this action will propagate itself progressively and explosively through the gas are examined. The heat of formation of N_2O is directly measured, use being made of this explosive thermal decomposition. The figure obtained is $19{\cdot}52 \pm 0{\cdot}1$ Cal./mol. at constant pressure. A simple method is given for comparing the values for two gases of the product pressure × volume, and is applied to the measurement of this product at pressures between 10 and 45 atmospheres in the cases of N_2O and of CO_2. AUTHORS.

765. Period of Induction in the Inflammation of Gas Mixtures. A. E. Malinovsky. *Acta Physicochimica*, 3. 4. *pp.* 509–516, 1935. *In English.*—A theoretical paper setting out a calculation of the induction period, for two extreme cases, based on the assumption that the rate of change in the number of active centres depends on both the first and the second powers of their available concentration. Reference is made to the work of Semenoff and Bone and Fraser. J. K.

***766. Duration of Luminosity Accompanying Detonations of Explosives. A. Michel-Levy and H. Muraour.** *J. de Physique et le Radium*, 6. *pp.* 496–498, *Dec.*, 1935.—Using a rotating drum and photographing with a small-aperture objective, the duration of the brilliant luminosity accompanying detonation is shown to be very small indeed. If the objective is used at a wide aperture and photographs taken at a greater distance it is shown that a much weaker luminosity of much longer duration also appears : and this reconciles the very short durations of

luminosity previously found by these workers [see Abstract 1728 (1935)] with the much longer durations found by other workers, who had used wide aperture objectives at large distances. D. H. F.

See also Abstracts 388, 706, 713, 787.

THERMODYNAMICS.

767. Equation of State. S. Ray. *Kolloid Zeits.* 73. *pp.* 269–272, *Dec.*, 1935.—The equation of state, based upon the author's colloidal theory of the van der Waals gas [see Abstract 1780 (1932)] is extended not only to small deviations from the equation of the perfect gas, but also to the saturated vapour state and actually to the point of condensation, *i.e.*, to the liquid phase. Use of two discontinuities in the data for saturated water-vapour, given by Zeuner in Landolt-Börnstein's tables, has afforded an interesting confirmation of the theory. These discontinuities provide a species of " retarded effect " in the determination of the constants. H. H. Ho.

768. Fluctuations in Density at the Critical Point. J. Yvon. *Comptes Rendus*, 201. *pp.* 1099–1102, *Dec.* 2, 1935.—In an elementary volume A, of a large volume V, of fluid maintained at constant temperature T, the average number of molecules is n, but the number at any instant is $n + \Delta n$. Hence the density of the volume A fluctuates, and Smoluchowski has shown that the mean square of the fluctuations in density, $\overline{\Delta n^2} = RTA\beta\nu^2/N_0$, where R is the gas constant, N_0 Avogadro's number, β the coefficient of isothermal compressibility, and ν the density in molecules per cm.^{3} at the point. It is considered that this relationship ceases to hold at the critical point, but that the difficulty can be overcome by taking account of weight in determining $\overline{\Delta n^2}$. This is now given by the formula $\overline{\Delta n^2} = -\int_A \int_{(V-A)} (\nu_{12} - \nu_1\nu_2)\, dw_1 dw_2$, ν_{12} being the probability coefficient in $\nu_{12} dw_1 dw_2$ used to find the centre of any molecule in the element of volume dw_1 and at the same time the centre of any other molecule in the element dw_2. $\overline{\Delta n^2}$ is always finite, and in a simple case it is shown that for a fluid at a distance from the critical point this expression agrees with Smoluchowski's form. R. W. P.

769. Partial Molal Volumes of Ammonia and Hydrogen in Liquid Ammonia-Hydrogen Mixtures under Pressure at 100°. R. Wiebe and T. H. Tremearne. *Am. Chem. Soc., J.* 57. *pp.* 2601–2603, *Dec.*, 1935.—The volumes of NH_3–H_2 mixtures in the liquid phase are measured. The partial molal volumes of both constituents are calculated. The thermodynamic significance of the data is discussed and the desirability of further measurements pointed out. AUTHORS.

770. Condensed Helium at Absolute Zero. F. London. *Roy. Soc., Proc.* 153*A*. *pp.* 576–583, *Feb.* 1, 1936.—It is shown why the application of the customary methods of lattice theory to condensed helium could not succeed and how it is possible roughly to take account of the decisive contribution of the zero point energy which is due to the quantisation of the mean free path. Closest packed structure has been found to be stable only under pressure and this seems to explain why solid helium can only exist, even at the absolute zero, under pressure. If no external pressure is applied a configuration with the coordination number four has proved to have considerably lower energy. It seems that this configuration gives a rough model of the liquid modification of helium which is stable at the absolute zero. AUTHOR.

771. Joule-Thomson Effect of Methane, Nitrogen and Mixtures of these Gases. J. H. Perry and C. V. Herrmann. *J. Phys. Chem.* 39. *pp.* 1189–1195, *Dec.*, 1935.—The Joule-Thomson coefficients of CH_4 and N_2 are calculated at 200, 250, 300, 350 and 400° K. and 1, 5, 25, 50 and 100 atmospheres, using the Beattie-Bridgeman equation of state. A method of obtaining the coefficients for mixtures of these gases from those of pure gases is indicated, and data for three mixtures of these gases are calculated and tabulated. AUTHORS.

772. Thermodynamic Potentials and Affinity. P. van Ryssel-berghe. *Comptes Rendus*, 201. *pp.* 1126–1128, *Dec.* 2, 1935.—The author shows that the Gibbs fundamental equation, $d\epsilon = tdy - pdv + \mu_1 dm_1 + \ldots \mu_n dm_n$, will be replaced by $\alpha Z = Xdx + \phi dy + \Sigma \alpha_i\ (x, y, m_1, \ldots, m_n)\ dm_i$, where Z is the thermodynamic potential relative to the variables x, y, when the Gibbs and le Chatelier hypotheses are made that the chemical potential $\mu_i\ (x, y, m_1, \ldots, m_n)$ is equal to each of the μ_i terms appearing in the formulæ: $\mu_i = (\partial\epsilon/\partial m_i)_{n,\ v,\ m} = (\partial X/\partial m_i)_{n,\ p,\ m} = (\partial \psi/\partial m_i)_{t,\ v,\ m} = (\partial\zeta/\partial m_i)_{t,p,m}$ $(i = 1, \ldots, n)$, and $\mu_i \equiv \mu^1{}_t\ (n, v, m, \ldots m_n) \equiv$ similar invariant relations. The partial derivatives of X, Y, $\mu_1, \ldots, \mu_n$, should satisfy the known conditions for dZ to be an exact differential, *e.g.* $(\partial \mu_i/\partial m_j)x,\ y = (\partial \mu_j/\partial m_i)x,\ y$ $(i, j = 1, \ldots, n)$. These relations are satisfied when (x, y) are respectively (n, v), (n, p), (t, v) or (t, p), but in general they will not be satisfied, since to given physical variables x, y, there would not always correspond a thermodynamic potential Z. It is also shown that the affinity A and the chemical potentials μ_i cannot be defined by the relations, $A = -(\partial Z/\partial\xi)_{x,y}$, $\mu_i = (\partial Z/\partial m_i)_{x,y}$, since the thermodynamic potential Z does not always exist. H. H. Ho.

773. Properties of Gas Fog. V. Njegovan. *Zeits. f. Physik*, 98. 5–6. *pp.* 415–416, *Dec.* 23, 1935.—Gas-fog in the vicinity of absolute zero [see Abstract 5114 (1935)] is shown to be similar to a very much reduced picture of the terrestrial atmosphere. With ordinary gases no change of pressure can be detected within a very small space due to distance from the earth's surface, *i.e.* a constant pressure exists throughout the entire interior of the gas. H. H. Ho.

774. Virial Theorem and Theory of Fusion. E. L. Hill. *Phys. Zeits. d. Sowjetunion*, 8. 4. *pp.* 401–406, 1935. *In English.*—A discussion is given of the meaning of the force function which is commonly used to describe the mutual interactions between molecules, and it is emphasised that this function contains a contribution from the kinetic energy terms of the electrons. From this fact, with further simplifying assumptions about the process of melting, a schematic explanation of the observed changes in kinetic and potential energies of the molecules along the melting curve is proposed. AUTHOR.

775. Useful Integrated Form of Equation for Change of Equilibrium with Temperature. J. B. Austin. *Am. Chem. Soc., J.* 57. *pp.* 2428–2434, *Dec.*, 1935.—By a simple transformation the equations relating the change of solubility with temperature can be changed into an approximate form which is in many cases more convenient for interpolation or extrapolation than the original equations. Thus it is shown that experimental values of these quantities fall on a straight line when plotted against the temperature, or the reduced temperature, on double logarithmic coördinates. The approximate equation for vapour pressure leads directly to the rules of Ramsay and Young and of Dühring. AUTHOR.

776. Zero-Point Energy of an Activated Complex and the Reaction $2NO + O_2 \rightarrow 2NO_2$. O. K. Rice. *J. Chem. Phys.* 4. *pp.* 53–59, *Jan.*, 1936.—Considerations, based on the uncertainty principle, have been brought forward which indicate that a reaction, whose rate is determined solely by a transitory activated complex in the formation of which classical degrees of freedom must be frozen out into vibrations, must have a positive activation energy at all temperatures, which increases with the temperature. A negative activation energy must mean the formation of a more or less stable intermediate compound, or " molecular complex." The theory has been applied to the reaction $2NO + O_2 \rightarrow 2NO_2$. AUTHOR.

777. Kinetic Treatment of Grain-Formation in Super-Saturated Vapours. R. Becker and W. Döring. *Ann. d. Physik*, 24. 8. *pp.* 719–752, *Dec.*, 1935.—A theoretical discussion of grain formation, largely based upon thermodynamics, in fluids, surfaces, and crystals. The question of ohmic resistance corresponding to the p.d. between small elements in chains is dealt with, and the results obtained are used in explaining and establishing the limits of validity of Oswald's " step-rule." [See also Abstract 2822 (1935).] F. I. G. R.

778. Thermodynamic Surfaces. P. Copel. *J. de Physique et le Radium*, 6. *pp.* 521–524, *Dec.*, 1935.—The author explains how his notions differ from those developed by Brillouin [see Abstract 3948 (1935)] and discusses briefly characteristic forms of thermodynamic surfaces showing the relationship between the various characteristic thermodynamic functions, *e.g.*, the Gibbs thermodynamic surface [S, *v*, U], the (T, *p*, H) surface, etc. The T, *p*, H surface represented in the T, *p*, plane by curves for which H = constant appears to be especially suitable for the representation of the thermodynamic properties of pure substances. J. S. G. T.

See also Abstracts **392, 474, 478, 481, 744, 745, 749.**

VAPOUR PRESSURE.

779. Vapour Pressures of Glycols. O. J. Schierholtz and M. L. Staples. *Am. Chem. Soc., J.* 57. *pp.* 2709–2711, *Dec.*, 1935.—The vapour pressure curves over the range 10–760 mm. are determined for the following glycols: ethylene, 1,2-propylene, 1,3-propylene, 1,3-butylene and 2,3-butylene. With the exception of ethylene glycol, these data are here reported for the first time. The densities and refractive indices are given for all the above compounds. The methods used for the preparation of 1,3-butylene and 2,3-butylene glycols are also described. AUTHORS.

780. Isopiestic Method of Determining Vapour Pressures of Salt Solutions. A. Janis. *Roy. Soc. Canada, Trans.* 29. *Sect. III. pp.* 87–89, *May*, 1935.—An isopiestic method is described for the measurement of vapour pressures, which is similar to that of Sinclair [see Abstract 3711 (1933)], but can accommodate samples as large as 20 cm.^{3}. The vapour pressure curve for NaCl solutions is determined using KCl solutions as reference standards, and the values obtained are compared at a temperature of 24·94° C. with results of Negus, Adams and Gibson and Lannung. No figures are given, but it is stated that there is disagreement in the results for the more dilute solutions. Those given by Lannung being erratic, while those of other workers showed systematic differences. R. W. P.

ACOUSTICS.

781. Singing Flames. Z. Carrière. *Rev. d'Acoustique*, 4. *pp.* 149–177, *July*, 1935.—The paper is concerned with what are ordinarily described as singing flames although the author restricts the use of the term to flames unassociated with resonators. The excited tube is placed horizontally to eliminate draughts, and the pressures at relevant points of the apparatus are measured by mirrors attached to capsules. The limits of stable excitation by the flame are discussed in terms of a plot of the maximum height of the flame in the excited state against its normal height. Experimental work, dealing, *inter alia*, with the rôle of the gas reservoir and supply tube and phase relations is reported. E. J. I.

782. Electrical and Acoustical Conductivities of Cylindrical Tubes Bounded by Infinite Flanges. L. V. King. *Phil. Mag.* 21. *pp.* 128–144, *Jan.*, 1936.—The problem, hitherto only solved approximately, of calculating the end resistance of a semi-infinite cylindrical conductor which is continuous with an unlimited medium of the same conductivity and bounded by an infinite insulating flange, is rigorously solved by making use of inversion theorems related to the theory of Bessel functions. The solution involves the use of infinite determinants, and by taking into account a sufficient number of terms the result can be obtained to any required accuracy. In the present instance 7 rows and columns of terms are used and the result obtained is $0{\cdot}82391 > \alpha/a > 0{\cdot}81873$ where α = the end correction and a = the radius of the tube. This value is lower than that given by Rayleigh (0·82422) but is in agreement with the estimate given by Daniell. J. E. R. C.

783. Application of Heaviside's Operational Methods to the Solution of the Pianoforte Problem. R. N. Ghosh and L. P. Verma. *Acad. Sci., Proc. U.P. India*, 5. *pp.* 15–26, *Sept.*, 1935.—An account of the applications of Heaviside's operational methods to the problem of string vibrations generated by the impact of an elastic hammer striking at any point of the string. The methods can be applied to determine (1) the pressure between hammer and string during contact, and (2) the total duration of contact. In the case of an elastic hammer, the pressure can be represented as the sum of a trigonometric convergent inharmonic series which, for a slightly elastic hammer, practically forms a harmonic series. The pressure rises continuously but sharply by a specified amount at intervals $2\alpha/c$, $4\alpha/c$, etc., and also at intervals $2\beta/c$, $4\beta/c$, etc., where α and β are the distances of the striking point from the ends of the wire, and c is the wave velocity along the wire. Further, the pressure components vanish which have a node at the striking point. The methods have also enabled the authors to obtain the solution of the problem in the form of pulses which are reflected from both ends of the string. [See also Abstract 1755 (1935).] G. E. A.

784. Ultrasonic Velocities in 52 Organic Liquids. S. Parthasarathy. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 497–511, *Nov.*, 1935.—The paper gives determinations of ultrasonic velocities at $7{\cdot}32 \times 10^6 \sim$ for 52 organic liquids and water by the method of diffraction of light by ultrasonic waves. It is shown how the velocity depends on chemical constitution. Included in the paper are adiabatic compressibilities for all the liquids studied, calculated from the well-known formula. AUTHOR.

785. Diffraction of Light by H.F. Sound Waves. Parts I and II. C. V. Raman and N. S. N. Nath. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 406–420, *Oct.*, 1935.—A theory of the diffraction of light by h.f. sound waves in a transparent liquid is developed. The case is investigated in which a plane beam is incident normally on the medium filled by the sound waves and travels in a direction perpendicular to that along which the sound is propagated. The formula is established : $\sin\theta = \pm n\lambda/\lambda_s$, where θ is the angle between the incident beam and the refracted beam, $\lambda\ \lambda_s$ are the wave-lengths of the incident light and the sound wave in the medium, and n is an integer $\geqslant 0$. The relative intensity of the m^{th} component to the n^{th} component is expressed as a ratio of Bessel functions. The theory interprets the experimental results of Bär [see Abstract 1250 (1934)]. In the second part the treatment is extended to the case in which the light waves are inclined at a definite angle ϕ to the direction of the sound waves. The diffraction spectrum is most prominent when ϕ is zero, and as ϕ is increased the intensities of the various components wander. The maxima of intensity of the diffracted light occur in directions θ such that $\sin(\theta+\phi) - \sin\phi = \pm n\lambda/\lambda_s$. The results explain the variations of intensity among the different orders observed by Debye and Sears for variations of ϕ. [See Abstract 4457 (1932).] G. E. A.

786. Stationary Supersonic Waves in Transparent Bodies. Part III. E. Hiedemann and K. H. Hoesch. *Zeits. f. Physik*, 98. 1–2. *pp.* 141–144, *Nov.* 30, 1935.—The authors' optical method of analysing h.f. elastic waves [see Abstract 4331 (1935)] is used in a simplified form to distinguish between the action of longitudinal and transverse waves in a glass block. J. E. R. C.

787. Deflagration of Explosives by Ultrasonic Waves. N. Marinesco. *Comptes Rendus*, 201. *pp.* 1187–1189, *Dec.* 9, 1935.—The temperature, T, to which a small air bubble is raised adiabatically by ultrasonic waves $= A\ (aF)^{1-1/\gamma}$, where a is the amplitude and F the frequency of the waves and A a constant. This is confirmed by the fact that certain explosives, *e.g.*, NI_3, Ag fulminate and some peroxide mixtures, for which the deflagration temperature is $< 234°$, immersed in a liquid which does not wet them, and subjected to such waves by means of a piezoquartz operating under p.d. 10^4 V (for which $F = 10^6$ and $T = 234°$) are deflagrated. No increase in a or F suffices to explode any nitro-derivative. C. A. S.

788. Dust Figures Formed by an Electric Spark. A. E. Bate. *Phys. Soc., Proc.* 48. *pp.* 178–182 ; *Disc.*, 183, *Jan.* 1, 1936.—The dust figures produced by the sound waves generated by electric sparks passing between a pair of spark gaps in series show interference. Measurements of the patterns made when the distance between the gaps ranged from 15 cm. to 3 cm. show that the wave-length of the sound is constant. When a single spark gap was placed between walls, the sparks produced modified patterns. These are explained by the method of images. The patterns may be regarded as sound maps, and should prove useful in illustrating acoustical phenomena such as the directive properties of cones for h.f. sound. AUTHOR.

789. Effect of Absorbing Surfaces on Propagation of Sound. L. Brillouin. *Rev. d'Acoustique*, 4. *pp.* 113–129, *July*, 1935.—The author deals with the effect of an absorbing surface on sound waves which are propagated parallel to it. A *résumé* is given of the experiments of v. Békésy on the subject [see Abstract 1574 (1933)] ; the consequences

of his conclusions on the acoustics of rooms are indicated ; and an attempt is made to give a reasoned explanation of the effects observed. E. J. I.

790. Porous Sound Absorbers of Variable Resistance. L. Cremer. *E.N.T.* 12. *pp.* 362–367, *Nov.*, 1935.—In previous papers [see Abstract 274 (1936)] the author has developed a theory of sound absorption in porous walls. In this theory the notion of current or flow-resistance (*strömungswiderstand*) is introduced. The present paper extends the theory to the case of a wall composed of multiple layers, having different flow-resistances, in contact with a rigid backing-wall. The case is analogous to the corresponding electrical system of transmission of electrical waves, without end reflection, in a cable. The treatment is mathematical. A. B. W.

791. Physiological Acoustics. S. Kagan. *Rev. d'Acoustique*, 4. *pp.* 130–148, *July*, 1935.—A description of the ear from an acoustical standpoint, and a *résumé* of present knowledge of some aspects of audition treated with special reference to the resonance theory. E. J. I.

792. Effect of Phase-Change on the Cochlea. H. Hartridge. *Phys. Soc., Proc.* 48. *pp.* 145–152. *Jan.* 1, 1936.—A change of phase in a siren tone is produced by means of a special spacing of the slots of the siren. A corresponding interruption of the tone is heard, in accordance with the resonance theory of audition. AUTHOR.

793. Transient Sounds. W. Bürck, P. Kotowski and H. Lichte. *Zeits. f. techn. Physik*, 16. 12. *pp.* 516–519, 1935.—Research on the audibility of free oscillations arising in reproducing systems reveals the importance of the loudness of clicks, recognition of pitch, and perception of small time differences. Experiments show that the ear acts as a linear receiver with frequency characteristics represented by the aural sensitivity contours, with an effective indication corresponding to time-constants between 50 and 150 millisec. The loudness of short-period sounds is determined by the energy of the applied amplitude spectrum, corrected for aural sensitivity. The basis of these conceptions is illustrated by calculations and diagrams, and correlated with experimental data with good agreement. Moreover, the results agree with Steudel's empirical loudness formula for clicks. [See also Abstract 5134 (1935).] L. E. C. H.

794. Transients in Sound Reproducing Systems. W. Bürck, P. Kotowski and H. Lichte. *Zeits. f. techn. Physik*, 16. 12. *pp.* 519–522, 1935.—The authors consider the spectral distribution in an impulse of tone. It has been shown [see preceding Abstract] how the loudness corresponding to such a spectral distribution can be calculated, but in some cases this is not convenient and methods of measurements are outlined. The pulse of tone is passed through a number of resonant circuits before being detected, the phenomena depending on the relation between the original frequency of the tone pulse and the frequencies of resonance. L. E. C. H.

795. Ground Noise Regulation. W. Bürck, P. Kotowski and H. Lichte. *Zeits. f. techn. Physik*, 16. 12. *pp.* 522–525, 1935.—The authors study the acoustic conditions necessary for automatically reducing the contrast in amplitude in normally recorded sounds in order to reduce the effective ground noise, arising in the recording medium, by subsequent expansion. The time-constant of adjustment of amplitude depends on the ability of the ear to accommodate itself to suddenly changed amplitudes of sounds. Taking this and other phenomena into account, it is

concluded that the time-constant for compression should be 0·3 millisec., while for expansion it should be 50 millisec. Shorter periods for the latter result in greatly increased blur-factor. L. E. C. H.

796. Vortex Noise from Rotating Cylindrical Rods. E. Z. Stowell and A. F. Deming. *Acoustical Soc. of America, J.* 7. *pp.* 190–198, *Jan.*, 1936.—A series of round rods of the same diameter were rotated individually about the midpoint of each rod. Vortices are shed from the rods when in motion, giving rise to the emission of sound. With the rotating system placed in the open air, the distribution of sound in space, the acoustical power output, and the spectral distribution are studied. The frequency of emission of vortices from any point on the rod is shown to be given by the formula of v. Kármán. From the spectrum, estimates are made of the distribution of acoustical power along the rod, the amount of air concerned in sound production, the "equivalent size" of the vortices, and the acoustical energy content for each vortex. AUTHORS.

797. Properties of Musical Sounds. O. Vierling. *Zeits. f. techn. Physik*, 16. 12. *pp.* 528–533, 1935.—The individual character of musical sounds is determined by the time characteristics of the amplitude and of the partial tone spectrum. Slight differences in these characteristics may produce very marked changes in the quality of the sound. Apparatus comprising a series of filters and a 6-strip oscillograph is employed to investigate the properties of various sounds, including various vocal sounds and sounds produced on the flute, harp and piano. The results obtained are shown in a number of interesting oscillograms which illustrate the part played by the various partials at the start, while the sound is maintained, and while it is dying away. A. W.

***798. Tone-Frequency Spectrometer. E. Freystedt.** *Zeits. f. techn. Physik*, 16. 12. *pp.* 533–539, 1935.—A description is given of an electrical frequency analyser which operates through a large number of electric filters arranged in parallel, the frequencies of the different filters being distributed over the frequency range to be analysed according to a logarithmic law. The amplitudes of the frequencies transmitted by the various filters are rendered visible by applying the corresponding potentials to a Braun tube, so that an amplitude spectrum is obtained. With the frequency range from about 40 to 5000 cycles and three filters per octave the time for a complete analysis is only about 0·1 sec., so that the spectrum can be regarded as practically simultaneous with the electric or acoustic phenomena in question. In the case of rapidly varying sound spectra a small film camera making about ten exposures per second has been found useful. Examples are given of the analysis of sounds and noises of various kinds. [See following Abstract.] A. W.

***799. Investigation of Rapidly Varying Sounds. F. Trendelenburg and E. Franz.** *Zeits. f. techn. Physik*, 16. 12. *pp.* 513–516, 1935.—Apparatus similar to that described by Freystedt [see preceding Abstract] is used to investigate the characteristics of sounds of various types, including various vowels and consonants and notes on various wind instruments. The frequency spectrum from 37·5 to 9600 cycles is divided by the filters into eight octaves and the output from any one of these is recorded simultaneously with the input on separate oscillograph strips. By the use of rotating contacts the outputs of the various filters can be obtained in quick succession and thus the characteristics of rapidly varying sounds can be clearly shown. Typical oscillograms are reproduced. A. W.

See also Abstract 456.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

800. High Resistance Measurement. J. A. van den Akker and G. M. Webb. *Rev. Sci. Instruments*, 7. *pp.* 44–46, *Jan.*, 1936.—A method is described for high resistance measurement which depends essentially on the fact that a small capacitance C, charged and discharged n times per second, is equivalent to a high resistance $1/n$C ohms if the pulsating current is smoothed by a larger capacitance. Upon placing the "equivalent high resistance $1/n$C" and unknown high resistance R, in two arms of a Maxwell bridge, it is shown that at balance, R is given by the familiar bridge equation: $R = (1/nC)R_1/R_2$. The method has been used to check the constancy of several electrolytic resistors three years old. It was found, for a resistance of the order of 10^8 ohms, that no change was detectable within 0·1 %, for resistors of the order of 10^{10} ohms, a decrease of about 3 % was noted. AUTHORS.

CONDUCTION AND DISCHARGE IN GASES.

801. Mechanism of Arc Discharge. O. Becken and R. Seeliger. *Ann. d. Physik*, 24. 7. *pp.* 609–635, *Nov.*, 1935.—It is explained that arc discharges may be either thermal arcs, field arcs or a combination of the two, depending on the nature of the electron emission from the kathode and the nature of the kathode. The paper describes a theoretical and practical investigation of the conditions appertaining to these types of arcs, and describes the apparatus and technique employed. A calculation of the kathode temperature is given, an investigation of the current strength at the striking of the arc for various electrodes in nitrogen is described and also the characteristics and appearance of the discharge, and current density measurements. The results for tungsten are discussed in detail. R. L.

802. Concentration of Sodium Vapour in the Arc. T. Peczalski and N. Szulc. *Comptes Rendus*, 201. *pp.* 1335–1337, *Dec.* 23, 1935. *In French.*—A carbon arc with its anode surrounded by a porcelain tube packed with NaCl is run with currents varying from 10 to 80A. The D-lines are observed to be very wide and reversed. From the width of the lines estimates are made of the number of Na atoms present; the number depends upon the current strength and the estimates range from 2×10^{16} to 7×10^{17} atoms/cm.^{3}. A. H.

803. Dynamical Similarity Laws of the Mercury High-Pressure Discharge. G. Heller. *Physics*, 6. *pp.* 389–394, *Dec.*, 1935.—Dynamical similarity laws of the high-pressure mercury-vapour discharge are set up. These laws are based on principles which determine characteristics of a high pressure discharge in thermal equilibrium. Characteristics of discharges can be determined by measurements on models if the model contains the same mass of mercury gas per cm. and is supplied with the same wattage per cm. of length of tube as the main construction. The temperatures of the walls of the discharge tube should be the same. In formulating the above requirements self-absorption is neglected. Experimental tests show the validity of the similarity theorems. AUTHOR.

804. Initiation of Electrical Discharges by Field Emission. J. W. Flowers. *Phys. Rev.* 48. *pp.* 954–959, *Dec.* 15, 1935.—The initiation of highly overvolted discharges produced in effectively ion-free gases by voltage impulses is shown to be independent of the nature and pressure of the gas between the electrodes, from pressures of 1 atmosphere until the vacuum spark stage is reached. Oscillograms showing time lags and potential falls in such discharges between spheres and between points and planes have been obtained, together with those of an ordinary discharge for comparison. When the breakdown is due to high kathode fields, the initiation is explained by field emission of electrons, but in the case of high anode fields, the initiation depends on the character of the surface. Oscillograms of the wave fronts produced by 60 ~ discharges between Mg electrodes, and the potential fall across such discharges have been obtained. J. E. R.

805. Preliminary Stages of Spark Formation in Gases. U. Nakaya and F. Yamasaki. *Roy. Soc., Proc.* 153*A*. *pp.* 542–554, *Feb.* 1, 1936.—The previous experiments on the application of the Wilson chamber [see Abstract 1229 (1935)] to the study of spark discharge are developed with improved equipment both in electrical and mechanical designs. With the present apparatus the authors succeed in taking reproducible photographs of the cloud tracks of preliminary discharge of spark in non-homogeneous fields. Discharge clouds are obtained in air, N_2, O_2, CO_2, H_2, and NO, and it is found that the form and structure of the preliminary discharge are quite different for different gases, each gas showing a characteristic feature peculiar to itself. The effect of admixture of a small quantity of some organic vapour is studied. Some chain compounds containing Cl or I, such as chloroform, methyl iodide, etc., are very effective in transforming the positive branched streamers in air into a smooth track. AUTHORS.

806. Pressure Effect on Discharge Radiation in Cadmium Vapour. W. A. Fabrikant and A. S. Kanel. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 6. *pp.* 257–258, 1935. *In German.*—The intensity of the visible radiation from an electrically heated Cd vapour discharge tube with oxide kathode is measured with a copper-oxide photo-cell and also with a visual spectrophotometer, the Cd vapour pressure being varied, and the current being kept constant at 3·5A. The photo-cell is affected entirely by Cd λλ5085, 4800 and 4676, and the visual instrument is used for Cd λ6438. The results are similar to those of Krefft and Elenbaas for Hg [see Abstract 3845 (1934)], but more distinct, possibly owing to better experimental conditions. As the Cd vapour pressure is raised the intensity increases rapidly at first, reaches a maximum at about 0·1 mm. Hg, falls rapidly to a minimum at about 1 mm., and then increases again when the column begins to contract. The intensity pressure curve near the minimum varies from line to line. Addition of an indifferent gas causes flattening of the curve, and if the gas pressure is high enough the minimum disappears completely. A is more effective than Ne, presumably on account of its greater effective diameter. W. J.

***807. Positive-Ion Energy in a Discharge Tube. W. Molthan.** *Zeits. f. Physik,* 98. 3–4. *pp.* 227–238, *Dec.* 14, 1935.—The construction of a probe electrode, electrically heated from the walls is described ; with this it is possible to estimate quantitatively the heating effect of ionic bombardment on the probe. Measurements with this apparatus show a linear

relationship between probe potential and the heat produced by unit current. In view of this relationship, the energy exchange processes, up to probe voltages of 200 V, cannot be explained on the assumption of electronic emission in appreciable amounts. It is suggested that the ions leave the probe, after neutralisation with velocities which are relatively large in relation to the temperature. This leads to an "accommodation coefficient" less than unity. Using the energy equation, together with these results electronic work functions are calculated, and values obtained in good agreement with those from other methods. J. E. R.

808. Electron Capture and Ion Formation in Gases. W. Rogowski. *Zeits. f. Physik*, 98. 5–6. *pp.* 399–414, *Dec.* 23, 1935.—The problem of the formation of negative ions and electron capture is considered from the point of view of the law of mass action. The process of ion formation is treated as a chemical problem, and the constants in the mass-action formula $c_1c_2/c_3 = Ae^{-B/T} \cdot T^C/p$ are evaluated, the electron being considered as a molecule of weight 1/1838. The special cases considered are the monomolecular ion, gas mixtures and multimolecular ions. Tables of constants are given. The capture of a positive ion by a neutral molecule to form a double ion is discussed from the same point of view. J. E. R.

809. Negative Atomic Hydrogen Ions. W. H. Bennett and P. F. Darby. *Phys. Rev.* 49. *pp.* 97–99, *Jan.* 1, 1936.—Negative atomic hydrogen ions are directly observed to exist at the heads of striations in discharges in water vapour. The ions appear to form surprisingly readily in these regions of high density of slow electrons, but they are lost very easily by collision. AUTHORS.

810. Anode Rays and Their Application to the Study of the Stark Effect. A. Poirot. *Ann. de Physique*, 4. *pp.* 533–645, *Dec.*, 1935. —Morand's method [see Abstract 2130 (1927)] of obtaining anode rays of Li has been extended to obtain those of Na, K, Ca, Ba and Cr. The facts of emission and luminous phenomena can be explained by a kind of electrolysis as well as volatilisation of the salt on the anode. These anode rays have been used to study the Stark effect, long exposures having been made with fields up to 160 kV/cm. The Li lines $2p$-mq ($m = 4,5,6,7$) have been observed, the last named for the first time; also the diffuse doublets, particularly $2p_{1/2}$-$6d$, of Na, and the triplets and singlets $2p$-$5d$, $2p$-$6d$, $3d$-$5f$ and $3d$-$6f$ of Ba. The rays have also been used to study the effect of crossed electric and magnetic fields upon spectral lines. F. S.

***811. Ion Sources for Mass Spectroscopy. A. J. Dempster.** *Rev. Sci. Instruments*, 7. *pp.* 46–49, *Jan.*, 1936.—Three spectroscopic methods of exciting spectra are examined as possible sources of positive rays. The vacuum vibrator, a mechanically interrupted low-potential spark, is found to give positive ions although the source is not constant. The discharge of a large condenser charged to 60 kV between metal electrodes, is found unsatisfactory as a source of positive ions. A h.f. alternating spark coupled inductively to a primary oscillating spark circuit, is a strong convenient source. The ions may be accelerated to form a beam, and, with the Thomson parabola method of analysis, it is found that multiply charged ions of the electrode elements are formed in all cases tried. AUTHOR.

812. Sensitised Decomposition of Hydrogen with Electrons of Controlled Energy. G. Glockler and L. B. Thomas. *Am. Chem. Soc., J.* 57. *pp.* 2352–2357, *Dec.*, 1935.—H_2 molecules are dissociated by

electrons of known speed using Hg atoms as a sensitising agent. These reactions are analogous to the photochemical decomposition of H_2 using $\lambda = 2537$ Å and Hg (Cario and Franck experiment). From the photochemical case it would be predicted that 4·9 eV electrons should initiate the mercury-sensitised reaction ; while without a sensitiser electrons must possess 11·7 eV energy. In the present experiment it is found that at low pressures (H_2 at 0·02 mm. and Hg at 0·002 mm.) the short-lived radiative states of mercury (4·9 and 6·7 eV) and the well-known metastable states ($6^3P_{0,2}$) are not efficient or are too short-lived to cause reaction. However, electrons of 7·7 eV energy can cause dissociation of H_2 in the presence of Hg. The sequence of reaction is $E^-(7{\cdot}7\text{ eV}) + Hg(6^1S_0) \rightarrow Hg(7^3S_1) + E^-(\text{zero eV})$. $Hg(7^3S_1) \rightarrow Hg(6^3P_{0,2}) + h\nu$ (5461 or 4047 Å). $Hg(6^3P_{0,2}) + H_2(^1\Sigma_g^+) \rightarrow 2H\,(\text{atoms}) + Hg(6^1S_0)$. $2H(\text{atoms}) + CuO(\text{solid}) \rightarrow H_2O\,(\text{liq.}) + Cu(\text{solid})$. AUTHORS.

See also Abstracts 380, 718, 788, 902.

CONDUCTION IN SOLIDS AND LIQUIDS.

813. Electrical Conductivity of Transition Metals. N. F. Mott. *Roy. Soc., Proc.* 153*A*. *pp.* 699–717, *Feb.* 1, 1936.—The quantum theory of electrical conductivity developed by Bloch and others is extended to metals where the conduction electrons occupy more than one Brillouin zone, as is the case for all real metals except the alkalis and noble metals. The theory is applied to the transition metals ; certain anomalies in the resistance temperature curves of the paramagnetic metals Pd, Pt, Ta are explained. A theory is given to account for the fact that the resistance of nickel decreases in a magnetic field, and an expression for the decrease obtained, which is of the same order of magnitude as that observed. Finally, a qualitative discussion is given of the resistance temperature curves of copper-nickel alloys such as constantan. AUTHOR.

***814. Supraconducting Galvanometer. H. G. Smith and F. G. A. Tarr.** *Roy. Soc. Canada, Trans.* 29. *Sect. III. pp.* 23–35, *May*, 1935.—The paper describes with specifications of its important parts a completely supraconducting galvanometer for measuring currents directly in supraconductors without introducing resistance in any part of the circuit. It is particularly suitable for measuring the Hall and thermoelectric effects. The characteristics of the galvanometer are developed from ordinary electrical theory. Experimental tests on the galvanometer are described which agree well with calculation. Preliminary results show more definitely than the magnetometer methods previously employed that persistent currents are really set up in a ring of supraconducting metal when acted upon by a change in magnetic flux through the ring. R. L.

815. Influence of Thermal and Mechanical Treatment on the Back E.M.F. and Current-Potential Relation in NaCl Crystals. A. Wenderowitsch and R. Drisina. *Zeits. f. Physik*, 98. 1–2. *pp.* 108–117, *Nov.* 30, 1935.—The use of Ohm's law for dielectrics is limited by the presence of a h.v. polarisation. The deviations from Ohm's law are examined for the case of NaCl and the effect of thermal treatment on the deviation is measured. Carefully annealed NaCl crystals show only a weak polarisation and Ohm's law is followed fairly accurately. The back E.M.F. due to polarisation decreases as the annealing temperature increases. Considerable deviations from Ohm's law are observed in the case of crystals which have not been annealed. It is suggested that the decrease in

conductivity observed at high temperatures may be related to the decrease in polarisation which is found at these temperatures. H. J. H. S.

816. Influence of Pressure on Electrical Resistance of Metals. M. H. Lenssen and A. Michels. *Physica*, 2. *pp.* 1091–1107, *Dec.*, 1935. *In English.*—Based on the wave mechanical theory of electrical resistance as developed by Nordheim the influence of pressure is discussed. This theory allows to consider separately the thermal-electrical and the "rest-resistance." Special consideration is given to the two limiting cases of practically free and practically bound electrons. The theoretical results are compared with those of other authors. Finally they are tested by comparing them with experimental results as found in the literature and with results published in a previous publication [see Abstract 3615 (1935)] where under certain assumptions it was possible to separate the pressure effect on the thermal-electrical and on the rest-resistance.

AUTHORS.

817. Electrical Resistance of Aluminium at Low Temperatures. H. A. Boorse and H. Niewodniczański. *Roy. Soc., Proc.* 153*A*. *pp.* 463–475, *Jan.* 1, 1936.—The electrical resistance of 6 polycrystalline Al wires is measured at 0° C. and at liquid N_2 and liquid H_2 temperatures. Measurement at liquid He temperatures is also made on four of the wires drawn from very pure Al. The resistance of these four specimens is found to be constant between 4·2° and 2·2° K. Reduced resistivities of these wires are computed from the Matthiessen-Nernst formula and compared with those calculated from an expression proposed by Grüneisen. Satisfactory agreement is found for liquid N_2 temperatures, but not for liquid H_2 temperatures. F. C. C.

818. Supraconductivity of Thin Metallic Films. A. D. Misener and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 29. *Sect.* III. *pp.* 5–11, *May*, 1935.—An investigation of the supraconductivity of thin tin films [see Abstract 442 (1935)] shows that the transition temperature is a function of thickness and that there is apparently a lower limit of thickness below which the films will not show supraconductivity. It is also found that these films are abnormally sensitive to current strength and that Silsbee's hypothesis [see Abstract 155 (1917)] could not be applied to them. It was thought that these effects might be due to the non-supraconducting allotrope of tin which is known to exist. Hence a similar investigation is carried out using films of lead, which is described in the present paper. The results for lead are found to be similar in the above respect to those already reported for tin. Some supplementary results are included for the tin investigation which confirm those given previously. The lower limit of the thickness of film of tin which would become supraconducting seems to be between 2×10^{-5} cm. and 4×10^{-5} cm. R. L.

819. Effect of Magnetic Fields on the Supraconductivity of Thin Films of Tin. A. D. Misener, H. G. Smith and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 29. *Sect.* III. *pp.* 13–21, *May*, 1935.—The influence of external magnetic fields on the supraconductivity of thin tin films is studied but no definite quantitative conclusions are drawn from the results. The authors, however, conclude that (*i*) the critical magnetic field necessary to interrupt the supraconducting state of tin is greater for thin films than for ordinary massive tin, (*ii*) greater transverse fields are required than longitudinal, (*iii*) transition from supraconductivity to normal resistance is comparatively gradual for the films and marked hysteresis is shown, (*iv*) these anomalies are still large for films many times

the critical thickness of $0 \cdot 9\ \mu$ at which the normal temperature transition begins to be seriously affected, (*v*) the critical magnetic field at a given temperature is lowered by increasing the current through the sample, (*vi*) the sensitivity of the transition points of the films to increase of current is a true current effect, apart from the magnetic field of the current and there must, therefore, be a maximum density for the supraconduction current. R. L.

820. Visible Electronic Substitution-Conduction in Alkali Iodide Crystals. E. Mollwo. *Göttingen Nachrichten, Fachgruppe* 2. 1. 20. *pp.* 215–220, 1935.—An excess of I in KI enables the process of electronic substitution-conduction to be watched in an alkali halide crystal. F. I. G. R.

821. Electric Resistivity and Magnetic Susceptibility of Sugar Carbon after Various Thermal Treatments. P. Corriez. *Comptes Rendus*, 201. *pp.* 1486–1487, *Dec.* 30, 1935.—The resistivities and susceptibilities of the same series of sugar carbons [see Abstract 411 (1936)] show respectively a steady decline and increase as the temperature to which they were heated was higher, those of the most strongly heated approximating most nearly to, but by no means attaining, those of graphite. C. A. S.

822. Influence of Accumulation on Field Distribution and Conductivity. W. O. Schumann. *Zeits. f. Physik*, 98. 1–2. *pp.* 72–74, *Nov.* 30, 1935.—By a series of measurements on the conductivity of solid and liquid media the accumulation of electricity carriers has been shown to be an important factor. The accumulated carriers have always, in contradistinction to the free-moving ones, a very small velocity. A short mathematical discussion is given. In some cases according to the spatial distribution of the places of accumulation the most varied forms of space charge can occur. J. J. S.

823. Electrical Conductivity of Silicate Minerals and Cut Quartz. H. Saegusa and T. Matsumoto. *Tôhoku Univ., Sci. Reports*, 24. *pp.* 537–550, *Nov.*, 1935. *In English.*—The anomalous variation with temperature of the electrical conductivity of some silicate minerals and of the so-called R-cut quartz is studied. It is found that in the case of the former the $\alpha \rightleftarrows \beta$ transformation of the quartz contained in the silicates occurs with slight anomaly due to the transformation of β quartz to tridymite, as also occurs in the case of the thermal expansion and of the heat absorption. In the case of the R-cut quartz the temperature coefficient of the electrical conductivity is found to be exactly similar to that of a quartz plate cut parallel or perpendicular to its optical axis. AUTHORS.

824. Action of Ultra-Violet Light on the Conductivity of Quartz. R. Radmaneche. *Comptes Rendus*, 201. *pp.* 1021–1022, *Nov.* 25, 1935.—A brief note on the effect of u.v. light on the electrical conductivity of quartz, using the same method as that used in studying the effect of temperature [see Abstract 4359 [1935)]. Typical current-time of irradiation curves are given which show at first a point of inflection. The current then rises rapidly and finally more slowly. Corresponding curves are also given showing the decrease of conductivity from the instant the u.v. light is shut off. R. L.

***825. Electric Conductivity of Copper Oxide in Strong Electric Fields. M. D. Borissow, I. I. Kara and K. D. Sinelnikow.** *Phys. Zeits. d. Sowjetunion*, 8. 4. *pp.* 425–429, 1935. *In German.*—The apparatus

is described for measuring the conductivity of Cu_2O at the temperature of liquid air for voltages up to 1800 V, to investigate the possible deviations from Ohm's law that may occur in strong fields. Curves of the results are given, the importance of the relation between current and time of application of the field is stressed, and polarisation effects are considered. The increase of electric conductivity with voltage is apparently connected with the increase in number of conduction electrons. R. L.

826. Electronic Conduction of Cuprous Oxide. W. Schottky and F. Waibel. *Phys. Zeits.* 36. *pp.* 912–914, *Dec.* 15, 1935.—A previously published result [see Abstract 313 (1934)] that the Hall effect of Cu_2O undergoes a sudden change of sign above about 500° C. is now considered contrary to the general rule and is also unsupported by Wagner's measurement of thermoelectric force over the same temperature range. These measurements are thought to have been made on a specimen poor in oxygen, and for Cu_2O which is rich in O_2 the Hall effect undergoes no change in sign. The implications of this result on the general theory of electronic conduction in semi-conductors is discussed. R. W. P.

***827. Observation of Space Charges and Ionisation Processes in Oil by Means of a Flow Arrangement. K. Christ.** *Zeits. f. Physik*, 98. 1–2. *pp.* 23–65, *Nov.* 30, 1935.—A flow apparatus is described which is arranged to produce flow of liquid at right angles to the electric field with the object of investigating the current conduction processes in dielectric liquids. It is an arrangement of concentric cylindrical electrodes through the intervening space between which the liquid flows. By this apparatus transformer oil was examined. On the flow of unpurified oil through the space between the electrodes, when no voltage is applied to the electrodes, currents are produced over each electrode which have the direction metal-oil. It is shown that their source is the spontaneous production of positive charge at the boundary surface oil-metal. The formation of a positive space charge before the kathode and a negative before the anode on current conduction was observed. Their order of magnitude was 10^{-12} to 10^{-8} coulomb with 0·1 to 3000 V. In distilled oil the positive charge which originates before the kathode is much smaller than with undistilled. The ratio of the mobilities of the positive and negative ions was measured by the flow method. It was found that the ionic mobilities are smaller than 5×10^{-5}. An alternating potential method was also applied to the observation of the production of ions and to the measurement of their mobility. J. J. S.

828. Space Charge in Liquid Dielectrics. J. B. Whitehead and E. E. Minor. *Physics*, 6. *pp.* 380–388, *Dec.*, 1935.—The potential distribution between parallel plates is determined for two insulating oils for voltages of 500 to 1500 and temperatures between 20° and 60° C. An unequal potential distribution is produced by an accumulation of space charge near the electrodes and extending also into the body of the liquid. The amount of space charge increases with increase of voltage and decreases with increase of temperature. When the voltage is reversed, the current after remaining constant for several seconds rises sharply to a maximum, and finally decreases to a constant value. It is suggested that two types of ion—one of high, and the other of low mobility—are involved in the space charge. From the variation of current on reversal, the mobilities of the ions are calculated, and it is shown that for different oils and for the same oil at different temperatures, the mobilities vary inversely as the viscosity. E. R.

*829. **Electric Coil-Winding Machine. H. P. Bloxam.** *Journ. Sci. Instruments*, 12. *pp.* 377–379, *Dec.*, 1935.—A machine is described for winding coils covering a wide range of sizes and wire gauges, and details of the circuit for controlling the speed of the motor are given. This machine has hitherto been used solely for experimental coils, *i.e.*, coils of which only a few of any one design are required, and hence no mechanical guide for feeding the wire on to the bobbin is provided. A device for this purpose could, however, be added, if required. AUTHOR.

See also Abstracts 386, 387, 475, 647, 777, 782, 800, 833, 867, 909.

DIELECTRICS AND CAPACITANCE.

830. Behaviour of the Ionic Cloud about a Dipole Molecule under the Influence of an Alternating Field. S. Oka. *Phys. Math., Soc. Japan, Proc.* 17. *pp.* 454–466, *Nov.*, 1935. *In German.* — This mathematical subject is dealt with under the following sections: The general fundamental equations for the determination of the ionic cloud; The transformation of coordinates; The supplementary dissymmetric distribution of charge about a dipole molecule under the influence of an alternating field; Limitation to consideration of electrolytes with two kinds of ions having the same frictional constant, in order to avoid mathematical complications; The ionic cloud about a dipole molecule in the stationary case; Calculation of the supplementary potential of the oscillating dipole; Calculation of the distribution functions; Supplementary distribution of charge in the vicinity of the dipole; Moment effect of the ionic cloud upon the central dipole. It is shown that in consequence of the finite relaxation period Θ of the ionic cloud there exists a turning moment, which damps the central dipole in its rotatory movement, similar to that of the relaxation force upon the movement of the central ion. The moment acts in the direction of diminishing the dielectric constant of electrolyte solutions and disappears for large values of $W\Theta$. H. H. Ho.

831. Relation between Molecular Orientation Polarisation of Substances in the Liquid, Dissolved and Gaseous States. (Mrs.) C. G. le Fèvre and R. W. J. le Fèvre. *Chem. Soc., J. pp.* 1747–1752, *Dec.*, 1935.—In a recent publication [see Abstract 3623 (1935)] it was suggested that the relation ${}_0P_1/{}_0P_2 = K(E_2 + 2)/(E_1 + 2)$ held between the orientation polarisations (${}_0P_1$ and ${}_0P_2$) developed by a molecule when surrounded by media of dielectric constants E_1 and E_2 respectively. With the aid of some new measurements now recorded and data collected from the literature (references quoted), the authors have examined its application to (*a*) 30 pairs of solutions, (*b*) 38 solutions and the solutes in the vapour state, (*c*) 58 solutions and the (liquid) solutes in bulk, and (*d*) 27 substances in the pure liquid and gaseous conditions. Only for class (*a*) is K found to be *ca.* unity; it is larger than 1·5 in 10 cases in class (*b*), in 24 cases in class (*c*), and in 15 cases in class (*d*). It has therefore become obvious that the rule as stated above is not of general applicability. A new expression is suggested, *viz.* ${}_\sigma P_{liq}/{}_\sigma P_{gas} = 1 - (E - 1)/(E + 2)f$, where f may be positive or negative and will relate to the geometry and polarisability of the molecules under consideration. An attempt is made to evaluate f, based on the assumptions that the molecules of a fluid are optically and electrically anisotropic, and that the polarisation field acting on a molecule in a dense fluid varies with its orientation relatively to the external field. H. H. Ho.

832. Molecular Structure of Dielectrics. W. H. Bragg. *I.E.E., J.* 77. *pp.* 737–748, *Dec.*, 1935.—By the methods of X-ray analysis, the molecular structure of solid bodies can be determined, and accurate information can be obtained of the atomic spacings and orientations. The structures of a number of materials such as durene, naphthalene, vitreous silica, bakelite, etc., are discussed. An explanation of the phenomena of residual charge and discharge in dielectrics is given, based on ionic movements within the structure. From a knowledge of the structure, the effect of the presence of dipoles in solid dielectrics is also considered. E. R.

833. Calculation of Various Physical Constants of Heterogeneous Substances. Part I. Dielectric Constant and Conductivity of Mixtures of Isotropic Substances. D. A. G. Bruggeman. *Ann. d. Physik*, 24. 7. *pp.* 636–664, *Nov.*, and *pp.* 665–679, *Dec.*, 1935.—Physical constants of heterogeneous substances, including the dielectric constant and the electrical and thermal conductivities of mixtures of isotropic constituents are calculated by a simple method from the constants of their homogeneous components. The accuracy of the older formulæ is investigated, and their unknown constants calculated. The theory is tested for the conductivity of heterogeneous metallic alloys and for the dielectric constant of compressed powders and emulsions; the various formulæ are confirmed and their application leads to more accurate determination of these constants. R. L.

834. Dielectric Constants of Mercury Halides. H. Braune and R. Linke. *Zeits. f. phys. Chem.* 31. *Abt.B.* 1–2. *pp.* 12–17, 1935.—The dielectric constants of $HgCl_2$, $HgBr_2$ and HgI_2 in the gaseous state are determined at temperatures between 320° and 430° C. The molecular polarisation is found to be independent of temperature. From the atomic polarisation, the moments of the Hg-halide bonds are calculated. E. R.

835. Discontinuity in the Dielectric Constant of Liquids and their Saturated Vapours at the Critical Temperature. J. Marsden and O. Maass. *Canad. J. of Research*, 13. *Sect. B. pp.* 296–307, *Nov.*, 1935.—A dielectric cell, which is specially adapted to a study of the dielectric constants of liquid and gas over a large temperature range, including the critical temperature region, is described. The dielectric constants of methyl ether (liquid and saturated vapour) and propylene (liquid and saturated vapour), from room-temperature to eight degrees above the critical temperatures, are given. The measurements show that the dielectric constants of liquid and gas are not identical at the critical temperature. These results are in agreement with previous work carried out in this laboratory on the discontinuity in properties of the medium above and below the point of disappearance of the meniscus. AUTHORS.

836. Dielectric Constants of Organic Liquids at Radio Frequencies. Part I. Carbon Tetrachloride and Chloroform. R. M. Davies. *Phil. Mag.* 21. *pp.* 1–41, *Jan.*, 1936.—The resonant circuit method was adopted as most suitable and a full description of this method, with precautions taken to ensure an accuracy greater than 1 in 1000, is given. A very detailed discussion of the results is included, the liquids being: (*a*) CCl_4, where dielectric constants at 20° C. and 25° C. are $2{\cdot}236_0$ and $2{\cdot}226_7$ respectively; the mean value of N_{20} is $1{\cdot}4603_0$; (*b*) $CHCl_3$, whose dielectric constants at 20° and 25° C. are $4{\cdot}796_4$ and $4{\cdot}708_6$ respectively; the mean value of N_{20} is $1{\cdot}4460_3$. A comprehensive section contains a discussion of the results of previous determinations. H. H. Ho.

837. Dipole Moments of Cyclo-Hexa-1 : 4-dione, Cyclo-Pentadiene-Benzoquinone, Benzoquinone, Carbon Suboxide and Carbonyl Chloride. (Mrs.) C. G. le Fèvre and R. J. W. le Fèvre. *Chem. Soc., J. pp.* 1696–1701, *Dec.*, 1935.—The dielectric constants, densities, and refractive indexes of solutions of the above substances in either benzene or CCl_4 at a known temperature are measured by methods described in previous papers, and thence the total polarisations, molecular refractivities, orientation polarisations, and dipole moments of the solutes are calculated in the usual way. From the data for cyclohexa-1:4-dione it is concluded that the compound is wholly ketonic ; the apparent dipole moment is 1·3D. Cyclo-pentadienebenzoquinone has an interest in relation to cyclohexadione, for, according to models, the requirements of ring strain must keep the ketonic groups rigidly in a *cis* mutual orientation. It is concluded that benzoquinone is non-polar, with a considerable exaltation of molecular refraction probably due to the highly conjugated arrangement of bonds. In benzene solution carbon suboxide appears to exist in a form corresponding to a rectilinear molecule. Saville and Shearer, from X-ray spectra, inferred that the valency angle of the CO group was 109–110° and from the dipole moment of $COCl_2$ the authors opine 115° to be a probable upper limit for the angle between the remaining two valencies of a keto-carbon atom. H. H. Ho.

838. Breakdown with Internal Photoelectric Effect. I. M. Goldman and B. M. Wul. *Phys. Zeits. d. Sowjetunion*, 8. 4 *pp.* 369–377, 1935. *In English.*—Experiments carried out with crystals of rock-salt show that the changes of electronic conductivity within a large range do not influence the dielectric strength of the material. The lowering of the breakdown potentials observed in stained crystals when subjected to light at direct and alternating voltages, are due to secondary factors. Authors.

***839. Measurement of Breakdown and Current Voltage Characteristics of Liquid Dielectrics with Direct Potentials. E. B. Baker and H. A. Boltz.** *Rev. Sci. Instruments*, 7. *pp.* 50–52, *Jan.*, 1936.—An arrangement is described which permits unusually accurate measurement of h.v. current characteristics and breakdown potentials of liquid dielectrics with d.c.. Currents from 10^{-16} to 10^{-3} A may be measured up to 40 kV. Protective devices are incorporated which prevent damage to the sample measured and to the instruments when breakdown occurs. Authors.

840. Temperature Coefficient of Dielectric Constant. C. Schusterius. *Zeits. f. techn. Physik*, 16. 12. *pp.* 640–642, 1935.—Measurements at frequencies of the order of a megacycle per second and at temperatures up to 400° C. show that the dielectric constant of TiO_2 is independent of frequency. After heating has caused traces of lower oxide to appear, the dielectric constant varies in a complicated fashion with both temperature and frequency. The author considers the effects to be due to metallic conduction by the lower oxide, especially as a small admixture of silver in a finely divided form has the same effect. Rutile (a natural titanium dioxide with iron oxides as impurities) is reported to show the same effects. Similar work on stannic oxide, and on mixtures of titanium dioxide and stannic oxide is reported. W. H. W.

See also Abstracts 827, 828, 849, 850.

ELECTROCHEMISTRY.

841. Activity Coefficients of Sulphuric Acid in Anhydrous Ethyl Alcohol from E.M.F. Data. A. W. Scholl, A. W. Hutchison and G. C. Chandlee. *Am. Chem. Soc., J.* 57 *pp.* 2542–2544, *Dec.*, 1935.—Activity coefficients of H_2SO_4 solutions in ethyl alcohol are determined by measurement of the cell H_2, H_2SO_4, $Hg_2SO_4(s)$, Hg. The data are treated by the Debye-Hückel equation and by the extended equation of Gronwall La Mer and Sandved. AUTHORS.

842. Electrolysis of Zinc, Nickel and Cobalt Bromides and Iodides in Aqueous Ethyl Alcohol Solution. C. Charmetant. *Comptes Rendus*, 201. *pp.* 1174–1176, *Dec.*, 9 1935.—With the same arrangement [see Abstract 3630 (1935)] and 0·5-*M* solutions, with $ZnBr_2$ Br liberated at the anode diffuses to the kathode and forms HBr and C_2H_4O, the amount increasing with concentration of EtOH. With ZnI_2 I is similarly liberated but does not react further. The Zn deposited is adherent with low concentrations of EtOH but becomes progressively less so as this increases above 450 g./l. The yield (maximum 97 %) decreases with time and increased concentration in EtOH. $NiBr_2$ and NiI_2 behave similarly, but with $NiBr_2$ less HBr and C_2H_4O are formed. As with $NiCl_2$ NiO is deposited at the kathode with evolution of H_2, but Ni if the solution is acid (0·01–0·025 *N* in HBr or HI). The yield increases with concentration of EtOH, and is always greater with $NiBr_2$ than with NiI_2 (maximum 93 and 90 % respectively). $CoBr_2$ and CoI_2 give similar results, save that no oxide is deposited and yield is slightly better (maximum 99·5 %). C. A. S.

843. Transition Cases in the Distribution of Ions. R. M. Fuoss. *Am. Chem. Soc., J.* 57. *pp.* 2604–2607, *Dec.*, 1935.—Using the ion pair distribution function previously derived by the author [see Abstract 4693 (1934)] a critical concentration is shown to exist, above which free and pairwise associated ions become indistinguishable. This concentration, $3·2 \times 10^{-7}D^3$ at 25° for 1-1 electrolytes, is experimentally the concentration above which the simple laws of dilute solutions of electrolytes are no longer obeyed, so that a numerical significance is attached to the phrase "at low concentrations." At higher concentrations, higher types of association must be considered for the case of non-aqueous solutions. AUTHOR.

844. Mobility of Hydrogen and Hydroxyl Ions in Aqueous Solutions. G. Wannier. *Ann. d. Physik*, 24. 6. *pp.* 545–568, *and* 24. 7. *pp.* 569–590, *Nov.*, 1935.—The paper forms a theoretical development of the Debye-Hückel theory combined with a quantum mechanical investigation of the changes. Equations are developed for calculating the mobility of H-ion and OH-ion and for the mean life of the ions. The calculated results agree with experiment. F. J. B.

845. Potential of Ag(s), Ag_2CrO_4(s), $CrO_4^=$ Electrode. Jessie Y. Cann and Gretchen B. Mueller. *Am. Chem. Soc., J.* 57. *pp.* 2525–2527, *Dec.*, 1935.—The cell Ag(s), Ag_2CrO_4(s), K_2CrO_4(aq), KCl(aq), AgCl(s), Ag(s) is investigated. The normal electrode potential of Ag(s), Ag_2CrO_4(s), $CrO_4^=$ is found to be $E^0 = -0·4463$ V ; $\Delta F^0 = 20{,}596$ cal. AUTHORS.

846. Unknown Property of Calomel Half-Cell and Estimation of Bromide-Chloride Mixtures. F. L. Hahn. *Am. Chem. Soc., J.* 57. *p.* 2537, *Dec.*, 1935.—The potential of a calomel half-cell is strongly influenced by even the smallest contents of bromide in the potassium

chloride used. It is possible to use this effect in order to obtain a rapid estimation of bromide in chloride. AUTHOR.

847. Mercury-Mercuric Oxide-Saturated Barium Hydroxide and Calcium Hydroxide Electrodes. G. J. Samuelson and D. J. Brown. *Am. Chem. Soc., J.* 57. *pp.* 2711–2714, *Dec.*, 1935.—The electrode Hg/HgO(s), $Ba(OH)_2$(s) is studied from the standpoints of ease of preparation, constancy, reproducibility and effect of temperature change. The potential of the electrode including a liquid junction, compared to the H_2 electrode at zero is $+ 0{\cdot}1462 - 0{\cdot}00060(t - 25°) \pm 0{\cdot}0002$ V. Likewise the potential of the electrode using ordinary materials is $\pm 0{\cdot}1462 - 0{\cdot}00060\ (t - 25°) \pm 0{\cdot}001$ V. The electrode using ordinary materials is very satisfactory for ordinary work. The electrode Hg/HgO(s), $Ca(OH)_2$(s) is studied from the standpoint of ease of preparation, constancy, reproducibility and temperature coefficient. The potential of the electrode against the normal H_2 electrode is $+ 0{\cdot}1923 + 0{\cdot}00010(t - 25°) \pm 0{\cdot}0010$ V. AUTHORS.

848. Spark Potential of Electrolytic Valve Action. W. Bär. *Zeits. f. Physik*, 98. 3-4. *pp.* 267–279, *Dec.* 14, 1935.—The characteristics of the so-called spark potential v_s, in electrolytic valve action, in sulphuric acid, and in solutions of borax either with or without addition of boric acid are investigated, electrodes made of Al, Ta, Sb, Bi or W being used. The value of v_s is found to be completely independent of current-density ; it increases slightly with increase of temperature. The value of v_s for an Al electrode is somewhat higher if the electrode is " preformed " for a long time at a lower potential. The value of v_s increases from 40 V in the case of absolute H_2SO_4 to 250 V for a very dilute solution. In borax solution the value of v_s increases from 185 V in 0·1 *N* solution to 270 V in very dilute solution. Values of v_s for the various electrodes in the same electrolyte range from 83 V in the case of Sb to 259 V for Al. The thicknesses of layer characterising incidence of the spark lie between 154 mμ for Ta and 500 mμ for Bi. The sparking voltage differs fundamentally in character form the maximum voltage, which, in the absence of disturbing factors, does not depend upon the metal of the valve electrode. J. S. G. T.

849. Formation of Anodic Oxide Film on Aluminium. E. J. W. Verwey. *Physica*, 2. *pp.* 1059–1063, *Dec.*, 1935. *In English.*—The mechanism of the electrolytic oxide coating process of Al is described in terms of a current of Al^{3+}-ions penetrating into a preformed lattice of O ions. This picture explains the peculiar structure of $\gamma' Al_2O_3$ (averaged structure of the kations) and is in rather good agreement with considerations based on lattice theory of electrolytic conductivity of crystals at high fields. [See Abstract 4072 (1935).] AUTHOR.

850. Dielectric Properties of Anodic Layers in Aluminium Electrolytic Condensers. J. E. Lilienfeld, L. Chandler, Jr. and S. Goldman. *Physics*, 6. *pp.* 416–425, *Dec.*, 1935.—With a new type of especially stable electrolytic capacitator, the dielectric properties of anodic layers are measured. The investigation shows that variations of the dielectric properties may be divided into two classes : lagging and non-lagging variations. Lagging variations, which include variations of the capacity and power factor with the operating voltages, are especially characteristic of anodic layers. They arise from the fact that the structure (organisation) of layers adjusts itself with changes of the operating conditions to a new dynamic equilibrium, within a short transition period. On the other hand, in regard to variations of the capacity and power factor

with frequency, which are non-lagging variations, anodic layers are similar to other composite dielectrics. An oscillographic study of harmonics is made which verifies the lagging nature of the changes of capacity with the operating voltages (a.c. and d.c.) and demonstrates for the first time the existence of a non-lagging variation of the a.c. conductivity with voltage. AUTHORS.

851. Passage of Current Through Thin Layers of Aluminium Oxide in Electron Tubes. H. Kessel. *Zeits. f. techn. Physik*, 16. 12. *pp.* 506–508, 1935.—The current potential characteristics of thin layers of Al_2O_3, produced electrolytically, were investigated in high vacuum by means of an "electron-gas kathode." The absolute values of the conductivity given by the current-potential characteristics, their dependence on temperature and also the capacitative balance values were found to be in very close agreement with results obtained with electrolytes. The results obtained favour the view that the conductive properties of "formed" oxide electrodes are appreciably affected by the chemical composition of the oxide layer and its variation with time. A. W.

852. Behaviour of Electrolytic Oxide Layers. R. Störmer. *Zeits. f. techn. Physik*, 16. 12. *pp.* 508–513, 1935.—An investigation was made of the current-time characteristics of an electrolytic aluminium oxide rectifier on sudden reversal of the polarity and of the current-potential characteristics of dry oxide layers, electrolytically produced, and the effect on these of previous kathodic treatment in electrolytes. The results are shown graphically and can be explained by the assumption that an electrical blocking layer is formed whose thickness and conductivity vary with the amount of oxygen absorbed or given off. A. W.

853. Method of Preparing Perfectly Polished Metallic Surfaces. P. Jacquet. *Comptes Rendus*, 201. *pp.* 1473–1474, *Dec.* 30, 1935.—The plate, *e.g.*, of Cu, of which a surface is to be polished (any portion not requiring polishing is to be varnished) is made the anode with a kathode of the same metal of slightly larger area. The electrolyte is a solution containing $\lessapprox$ 400 gm./l H_3PO_4 or $H_4P_2O_7$ (HPO_3 is useless), at 15–25°. The current required depends on the concentration of the solution and the position of the anode, thus with 530 gm./l H_3PO_4 and anode vertical it should be 10 A/dm.^{2}, but with it horizontal 6 suffice, in about 15 min. The p.d. should be such as just does not cause the appearance of bubbles on the anode. [See Abstract 4074 (1935).] C. A. S.

854. Relations between Electrochemical Constants, Infra-Red Spectra and Reactivities. F. Vlès. *Comptes Rendus*, 201. *pp.* 1475–1477, *Dec.* 30, 1935.—The atom or group responsible for the absorption band for which the relation $\lambda p\mathrm{K} = 21{\cdot}2$ holds has been identified in several cases. In benzoic acid it is the CO group, in aniline the N^{III} atom; in anthranilic acid the acid and basic functions have pK 4·95 and 2·10 corresponding to λ 4·28 and 10·1 respectively. The values of pK for the half decomposition of urea by urease indicate the presence of N^{III} and N^{V}, and so support Werner's cyclic structure. C. A. S.

See also Abstract 830.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

855. Positive Electron. A. T. Waterman. *Am. J. Sci.* 30. *pp.* 541–548, *Dec.*, 1935.—An account is given of the discovery of this, the

most recent elementary physical particle, and its subsequent verification by several investigators. The main features of the experimental results are explained. A statement is made of the quantitative evidence now available regarding the properties of positrons and the energy required to produce them. Mention is also made of the hypothesis attributed to Dirac concerning the cause of the appearance and disappearance of these particles, with an outline of some of the recent information on the point. AUTHOR.

856. Geometrical Relations Exhibited by Material Particles. E. Sevin. *Comptes Rendus*, 201. *pp.* 1466–1468, *Dec.* 30, 1935.—The various constants of nature, and combinations of such constants, such as the radius of the neutron, of the electron or of the proton, the constant $hc/2\pi e^2$ and the Compton wave-length, are decomposed into sums of squares and represented by the sides of right-angled triangles. Those involving the factor 137 are also pointed out. G. C. McV.

857. Absorption of Particles of Great Energy. J. Solomon. *Comptes Rendus*, 201. *pp.* 1110–1112, *Dec.* 2, 1935.—The correction required in the ordinary quantum mechanics formulæ for the loss of energy of an electron by radiation or of a photon by production of pairs when the energy of the colliding particles approximates to $137mc^2$ is calculated. For Pb and electrons of energy $20mc^2$ or $40mc^2$ it is of the order of 5 %. [See Abstract 3411 (1934).] C. A. S.

858. Oxidation of a Crystal Surface Studied by Means of Kathode-Ray Reflection. T. Yamaguti. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 443–453, *Nov.*, 1935. *In English.*—Effects of oxidation and of etching of cleaved surfaces of zincblende on the reflection of kathode rays are investigated. By the analysis of diffraction patterns of the rays it is shown that the oxidised product (ZnO) of zincblende is a single crystal, being so oriented that the (103) plane of ZnO is resting on the cleaved surface (110) of ZnS, and moreover the [010]-axis of the former is found to be parallel to the [110]-axis of the latter. By taking into consideration the temperature effect in Waller's sense, a new interpretation is given of the formation of *N*-pattern. [See Abstract 1838 (1935).] AUTHOR.

859. Scattering of High Speed Electrons. A. Matveiev and F. Vergunas. *Phys. Zeits. d. Sowjetunion*, 8. 4. *pp.* 430–442, 1935. *In English.*—The angular distribution of electrons of 200–240 kV energy after nuclear scattering in Al, Pb and Ag is investigated. The experimental results are compared with the theories of nuclear scattering and a difference is found in the magnitude of scattering with light and heavy nuclei. AUTHORS.

***860. Universal Camera for Electron Diffraction at 10 to 100 kV. H. J. Yearian and J. D. Howe.** *Rev. Sci. Instruments*, 7. *pp.* 26–30, *Jan.*, 1936.—A camera is developed for electron diffraction to be used with either a hot filament kathode or kathode rays from a discharge tube. The camera is equipped with a specimen holder which allows diffraction patterns to be taken with either reflected or transmitted electron beams. The specimen can be rotated for investigation of fibre structure or orientated crystal growth ; it also can be cooled to − 180° or heated to 600°. The camera is equipped to take 40 exposures without re-evacuation. The time of exposure can be preselected in the range from 1/10 sec. to 1 min. An arrangement to photograph the diffraction pattern of a standard substance on the same plate with that of the specimen under

investigation eliminates the necessity of an accurately calibrated high tension voltmeter. The whole assembly is connected with rubber gaskets allowing a quick interchange from one type of camera or electron source to the other. Diffraction patterns can be obtained with electrons of 10–100 kV energy. AUTHORS.

861. Electron-Optical Image Structure and its Bearing on the Emission of Ba-Ni Kathodes. E. Brüche. *Zeits. f. Physik*, 98. 1–2. *pp.* 77–107, *Nov.* 30, 1935.—Examination of hot kathodes with the electron microscope often reveals the surface crystal structure of the kathode. A review of the work on Ba kathodes shows that the surface structure is a final state which is independent of the numerous intermediate phenomena associated with the various methods of activation of the emitting surface. The migration of Ba on the kathode is discussed and different types of migration are described. The development of structural images of vapour deposited kathodes is summarised and alterations in surface structure due to variation in thickness of the deposited layer are described and discussed theoretically with reference to the Richardson law. Images of kathodes obtained by means of photoelectrons liberated from their surfaces show only the surface structure whereas images of hot kathodes show crystal structure in addition. A number of theoretical deductions are made from experimental data and the Schrot and Funkel effects are briefly discussed as well as the important part played by crystal boundaries in the emission. H. J. H. S.

***862. Electron-Optical Image Formation with Emitting Wires. H. Mahl.** *Zeits. f. Physik*, 98. 5–6. *pp.* 321–322, *Dec.* 23, 1935.—An arrangement is described whereby electron optical images of a wire may be obtained by means of an electrical lens. It is essential that the equipotential lines in the neighbourhood of the wire should be plane in order to avoid image distortion. This result is achieved by suitably disposing a subsidiary electrode at a small negative potential. Images of thoriated W and thoriated Mo wires of diameter 0·3 mm. are obtained with an accelerating potential of 10 kV and a negative potential of 0·6 to 1 kV on the subsidiary electrode placed 1 mm. away from the wire. H. J. H. S.

863. Electrostatic Focusing at Relativistic Speeds. W. W. Hansen and D. L. Webster. *Rev. Sci. Instruments*, 7. *pp.* 17–23, *Jan.*, 1936.—Power series are derived with which, given data on the electric field, the focal properties of some common electron lenses can be quickly computed even when the speed of the electrons approaches that of light. The expansion is in powers of the ratio of the p.d. across the lens to the sum of the p.d.'s between its electrodes and the kathode (for electrons) or anode (for positive ions), squares of this ratio being neglected in comparison with unity. As an example the focusing properties of two cylinders almost in contact are calculated. [See following Abstract.] AUTHORS.

864. Ion Optics of Equal Coaxial Cylinders. P. Kirkpatrick and J. G. Beckerley. *Rev. Sci. Instruments*, 7. *pp.* 24–26, *Jan.*, 1936.—The potential distribution along the axis of two long equal coaxial conducting cylinders has been found to be empirically expressible in terms of the radius and separation of the cylinders. The empirical expression checks well with the single special case (zero separation) which is known to have been solved analytically. The general empirical expression, combined with the theoretical lens equation of Hansen and Webster [see preceding

Abstract] yields an algebraic formula for lenses of this type directly relating object and image distances to readily measurable quantities. AUTHORS.

See also Abstracts **367, 596, 602, 724, 743, 756, 914.**

ELECTROSTATICS.

***865. Ionic Generator for High Potentials. M. Pauthenier and Marguerite Moreau-Hanot.** *Comptes Rendus*, 201. *pp.* 1332–1334, *Dec.* 23, 1935.—Dust-laden gas is aspirated round a circuit, passing first along an ionising tube in which the axial wire is maintained at a potential of $\pm$ 10–15 kV, next through a U-tube of conducting material enclosed in the sphere (30 cm. dia.), to be charged. The middle portion of the U-tube is flattened to ensure contact of the charged particles therewith. The gas then passes back to the aspirator. A potential of 450 kV was thus rapidly obtained on the sphere. Calculations show that there should be little difficulty in obtaining much higher potentials. C. A. S.

***866. Belt-Type Electrostatic Generator with Small Vertical Clearance. W. H. Bennett.** *Rev. Sci. Instruments*, 7. *pp.* 53–54, *Jan.*, 1936.—A h.v. electrostatic belt-type generator has been built, in which nearly horizontal ropes are used for support instead of the usual vertical supporting textolite cylinder. This new arrangement turns surfaces with maximum radius of curvature towards the shortest gaps, above and below. Evidence is presented to show that this arrangement gives the maximum voltage for a room with limited height. AUTHOR.

***867. New Construction for Evacuated Duant-Electrometer. Parts I and II. G. Hoffmann and B. Zipprich.** *Phys. Zeits.* 37. *pp.* 35–38, *Jan.* 1, 1936.—Describes an improved construction now employed for the vacuum type of Hoffmann's duant-electrometer. The adjustment of the distance between duants and needle is now made by moving the duants instead of the needle. The instrument is also made so as to be more easily opened for inspection, and the old form of contact keys have been replaced by mercury-switches, electromagnetically operated. The high sensitivity of the instrument has been retained, but its use simplified. L. H.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

868. A.C. Resistance of Nickel in a Longitudinal Magnetic Field. M. M. Sen Gupta, H. B. Mohanti and S. Sharan. *Zeits. f. Physik*, 98. 3–4. *pp.* 262–266, *Dec.* 14, 1935.—The influence of a magnetic field on the resistance of Ni is investigated with an a.c. bridge. The alternating current resistance differs from the direct current resistance in that the hysteresis is smaller, there is no remanent resistance, and the resistance is not the same function of the magnetic field. A close relation is found to exist between the resistance change and the magnetisation of the substance. The a.c. resistance plotted in dependence on the magnetic field is free from many of the irregularities often shown by the d.c. resistance. J. E. K.

869. Passage of Electricity in a Magnetic Field when the Electrodes are Points. G. Giraud. *Accad. Lincei, Atti*, 22. *pp.* 334–341, *Oct.*, 1935.—The conditions which must be satisfied inside and at the surface of a conductor in a magnetic field are shown mathematically, also the

equations between the fields and e.m.f.'s. New hypotheses are introduced and the conditions at the surface examined. The whole is considered mathematically and equations obtained for an electric flux entering a conductor by a point electrode and leaving at second point. H. M. B.

870. Thermomagnetic Properties of Nickel. Part II. W. Band and Y. K. Hsü. *Phys. Soc., Proc.* 48. *pp.* 168–177, *Jan.* 1, 1936.—The homogeneous thermoelectric e.m.f. in nickel is examined for various tensions up to 8 kg. in a pure wire of diameter 1 mm. Analysis gives the new constants (Benedick coefficients) as functions of magnetic field and tension. An antisymmetric part of the e.m.f. with respect to the magnetisation has been discovered. Evidence suggesting that the effect is controlled by the regularity (anisotropy) of arrangement of the microcrystals within the wire is given. [For Part I see Abstract 4005 (1935)].

AUTHORS.

See also Abstracts 814, 826.

MAGNETISM AND ELECTROMAGNETISM.

871. Expression of Equations of Electromagnetism in Terms of Clifford's Numbers. A. Mercier. *Arch. des Sciences,* 17. *pp.* 305–339, *Sept.–Oct.,* 1935.—Clifford's numbers, N, are defined as $N = a + \Sigma a_i \lceil_i + \Sigma a_{ij} \lceil_i \lceil_j + \ldots + a_{12\ldots n} \lceil_1 \lceil_2 \ldots \lceil_n$, where the $\lceil_i$ possess the properties $\lceil_i \lceil_j + \lceil_j \lceil_i = 0$, $\lceil_i^2 = 1$ for $i = 1 \ldots n$, and the $a, a_i, a_{ij}, \ldots$ are the components of tensors of rank zero, one, two, etc., respectively. The tensors of rank higher than the first are all anti-symmetric. The properties of these numbers, particularly the analysis based on them, is developed. It is then shown how they can be used to express the equations of classical electromagnetism in a condensed form. G. C. McV.

872. Harmonic Electromagnetic Waves. G. A. Maggi and B. Finzi. *Accad. Lincei, Atti,* 22. *pp.* 200–202, *Sept.,* 1935.—It is possible to find harmonic solutions of a certain type of the equations of the electromagnetic field, which satisfy not only Maxwell's equations but also Love's conditions on the wave-front. A. J. McC.

873. Magnetisation of Single Crystals of Nickel. K. Honda, H. Masumoto and Y. Shirakawa. *Tôhoku Univ., Sci. Reports,* 24. *pp.* 391–410, *Nov.,* 1935. *In English. Report No.* 348 *of the Research Inst. for Iron, Steel and other Metals.*—The magnetisation of single crystals of nickel at various temperatures ranging from −252° to 370° is measured by the ballistic method. At ordinary temperature in the direction of the [111] axis it rises at first rapidly and then slowly with the increase of the field and afterwards reaches a saturation value. As the temperature is raised, the magnetisation in weak fields becomes gradually easier and the saturation value becomes less. The magnetisation curves in the direction of the [110] and [100] axes have a form similar to each other; they are almost the same as in the case of the [111] axis, but at low temperatures, the saturation value is not reached even in a field of 1000 oersteds. The saturation value of magnetisation of nickel crystal at absolute zero is estimated to be 523 gauss. AUTHORS.

874. Magnetic Properties and Orientation of Ferromagnetic Particles. C. W. Davis. *Physics,* 6. *pp.* 376–379, *Dec.,* 1935.—The effect of heat treatment and of particle orientation on the magnetic properties of granular pyrrhotite are discussed and illustrated by curves

and data. Heat treatment which causes little or no chemical change alters pyrrhotite so that increased induction and remanence and decreased coercive force result. Particles aligned in a field parallel to that used in their magnetic measurement showed greater induction and remanence but less coercive force than randomly oriented material, while cross-oriented particles showed the lowest induction and remanence but the greatest coercive force. [See Abstracts 1864 and 3178 (1935)]. AUTHOR.

875. Magnetochemistry of Rhenium. N. Perakis and L. Capatos. *J. de Physique et le Radium*, 6. *pp.* 462–468, *Nov.*, 1935.—An investigation of the magnetism of metallic and of heptavalent Re is carried out; in both states a slight paramagnetism is obtained. For the metal the value is $0{\cdot}366 \times 10^6$. The value for the heptavalent ion is obtained by examining the perrhenates of NH_4, K, Rb, and Cs, and rhenium heptoxide, and deducting the magnetism of the other parts of the molecule, obtained by comparison with perchlorates and, for the heptoxide, the value for the group O_7 is obtained by investigating potassium pyrosulphate. The value for heptavalent Re is $0{\cdot}049 \times 10^6$. W. R. A.

876. Paramagnetism of Rare-Earth Crystals by Measurement of the Paramagnetic Rotatory Power. J. Becquerel. *Comptes Rendus*, 201. *pp.* 1112–1115, *Dec.* 2, 1935.—The ethylsulphates of praseodymium, neodymium, erbium, and dysprosium are investigated. It is concluded that these substances do not obey Curie's law on account of an energetic decomposition due to the internal electric field. W. R. A.

877. Magnetic Susceptibility of Halides of Alkalies and Alkaline Earths. U. Veiel. *Ann. d. Physik*, 24. 8. *pp.* 697–713, *Dec.*, 1935.—Measurements were made of the susceptibility of halides of alkalies and of alkaline earths and of halogen hydrides in aqueous solution as function of the concentration. Calculations are given of the susceptibilities of the ions in the solution and of the free ions with critical treatment of the methods of estimation. Measurements of the dependence of the susceptibility on concentration and temperature in solutions of KI are also given. The measurements of the susceptibility were made by Quincke's method of rise of height as improved by Auer. J. J. S.

878. Principal Magnetic Susceptibilities of $K_3Fe(CN)_6$. J. B. Howard. *J. Chem. Phys.* 3. *pp.* 813–817, *Dec.*, 1935.—The magnitudes, anisotropy and temperature dependence of the principal magnetic susceptibilities of $K_3Fe(CN)_6$ are calculated by the method of crystalline potentials, and are in good agreement with experiment. The assumption is made that the interatomic forces in the $Fe(CN)_6^{---}$ complex destroy the Russell-Saunders coupling. This results in a susceptibility corresponding to one free electron spin with a contribution, except at very low temperatures, from the unquenched orbital angular momentum. The superposition of a small rhombic crystalline field suffices to produce the large observed magnetic anisotropy. The behaviour of the susceptibility of $K_3Fe(CN)_6$ is in sharp contrast to the higher effective magneton numbers and magnetic isotropy of many ferric compounds, such as the sulphates. G. E. A.

879. Magnetism and Polymerisation. J. Farquharson. *Faraday Soc., Trans.* 32. *pp.* 219–226, *Jan.*, 1936.—Polymerisation gives rise to a change in diamagnetic susceptibility which can be followed quite easily. As polymerisation proceeds, the mass susceptibility follows a curve which, in the normal case, is a hyperbola. If the degree of polymerisation is not too great then it can be calculated by using Pascal's atomic values or

constitutive constants. Pascal's values can also be used to explain the changes in susceptibility when the polymers can be separated.

AUTHOR.

***880. New Full-Range Permeameter. B. M. Smith.** *Gen. El. Rev.* 38. *pp.* 520–521, *Nov.*, 1935.—Describes a permeameter equipment which covers a wide range of tests from low induction to magnetic saturation. The permeameter itself has a normal test range of from H = 0·001 to 1000 oersteds, and requires but one test-piece which may be either of strip or bar form. The ballistic method of measurement is used and there are 4 coils—the main magnetising winding, a coil surrounding the specimen and measuring the flux changes in it, a compensating coil and a coil to measure the magnetising force applied, the two latter being wound on a core of insulating material. In order to facilitate the use of the instrument, the complete equipment is assembled in a convenient table form completely wired and ready for use when the instruments are set in place and connected. R. C. F.

***881. Improved Curie-Chéneveau Magnetic Balance. F. W. Gray, A. Clow, and J. H. Cruickshank.** *Journ. Sci. Instruments*, 13. *pp.* 13–20, *Jan.*, 1936.—The following improvements are described for the magnetic damping type of Curie-Chéneveau Balance, additional to those already given by Gray and Farquharson [see Abstract 2148 (1932)]. Instead of the wooden roof and floor of the balance case, there is substituted a heavy supporting frame of brass to carry the various parts of the instrument; for the cork stopper of the container is substituted a hollow stopper of the same low-susceptibility glass as the container; to avoid having to readjust the beam in the course of a determination, compensating weights are used to ensure that the vertical forces (weights) applied to the beam and their distribution are maintained unchanged in every detail throughout the whole determination; details are also given of a modified technique.

AUTHORS.

See also Abstracts 407, 418, 419, 463, 666, 821, 829, 869, 870.

MEDICAL RADIOLOGY AND ELECTROLOGY.

882. Electrical Phenomena in Men and Animals. H. Koch. *E.T.Z.* 53. *pp.* 1248–1250; *Disc.*, 1263–1265, *Nov.* 14, 1935.—A general discussion on the construction and electrical properties of nerves. Using a.c. it is shown that the response between 200 and 1200 ~ is similar to that of hearing. The question is discussed whether impressed electrical vibrations could make a deaf person hear. The effect of immersion in caffein is illustrated, and it is shown that immediately after immersion the nerve is less sensitive, but after an interval becomes more sensitive than normal. G. E. B.

***883. Energy Considerations of Short-Wave Therapy Generators. E. Mittelmann.** *E.u.M.* 53. *pp.* 568–571, *Dec.* 1, 1935.—Medical short-wave generators differ from normal wireless transmitters in respect to the type of load. With wireless transmitters the ohmic resistance of, for example, the aerial has to be kept low, whilst with the medical application, the object is the development of heat. The electrical conditions are discussed on the basis of curves and a schematic circuit including the object of treatment, particularly in respect to the phase conditions. With the usual medical generator, and an energy consumption of 1·5 kW, the energy in the actual treatment circuit is about 100 W, this theoretical

value being confirmed by actual measurement. A photometric method of measuring the energy actually received by the patient is described, and discussed mathematically. Generators of at least 1 kW consumption are essential for the treatment of large or extensive regions of the body to produce heating with short waves, and for this reason large electrodes must be employed to avoid a large capacitative load and allow evenness of heat distribution. The measuring apparatus described permits tuning of the apparatus in respect to the patient and hence application of maximum energy to the patient. B. J. L.

884. Wave-Length and Specificity of Short Waves. L. Delherm and H. Fischgold. *J. de Radiologie et d'Électrologie*, 19. *pp.* 709–712, *Dec.*, 1935.—Short wave or ultra-short waves, as used for medical purposes, are merely a type of d'Arsonval treatment, the latter comprising all such treatments, irrespective of wave-length. Capacitative effects occur as in diathermic treatment. There is no evidence of any specific action, particularly in respect to any effect of wave-length. The radiation increases nerve chronaxy and, thereby, has a sedative effect in respect to neuralgia. In this respect the action is opposite to that of heat, which diminishes the neuro-muscular chronaxy and, thereby, has an exciting action upon neuralgia. A specific effect must be distinguished from the selective effect, the specificity being consistent with modern physiological conceptions. B. J. L.

885. Speedier Production of the Finished Radiograph. A. E. Barclay. *Brit. J. of Radiology*, 8. *pp.* 722–724, *Nov.*, 1935.—Discusses some difficulties experienced in a method described in an earlier paper [see Abstract 3675 (1935)]. In drying films on an endless belt, trouble is experienced due to irregular drying caused by still-air pockets, but this is overcome by supporting the films on suitable points, and causing them to be agitated so that the points do not stick when tacky. Modern safety films cannot be dried and finished by the method outlined as, being softer than the ordinary type they are easily mutilated in the drying rollers, and in drying they curl and it proves impossible to dry them satisfactorily on the moving belt. G. E. B.

886. Effect of Atmospheric Ozone on the Biological Activity of Solar Radiation. R. Latarjet. *Rev. d'Optique*, 14. *pp.* 398–414, *Nov.*, 1935.—The author gives reasons for choosing the production of erythema as the basis for estimating the biological activity of radiation and defines erythemal activity. Curves showing the variation of this activity (expressed in finsens) with wave-length in the region 2900 to 3300 Å, for reduced ozone layer thicknesses from 2 to 4 mm. are given. Graphical integration of these yields a curve which shows the variation of the activity of solar radiation with the reduced ozone layer thickness and a formula which fits this curve is derived. W. E. P.

***887. 300 kV X-Ray Treatment Machine. J. T. Murphy.** *Am. J. of Roentgenology and Radium Therapy*, 34. *pp.* 653–658. *Nov.*, 1935.—Favourable results of X-ray treatment of superficial new growths are attributed to heavier dosage than can be given deeply. Increased voltage permits a heavier depth voltage, irrespective of other factors mentioned. As compared with the more usual treatment at 200 kV, the author uses an apparatus capable of exciting the tube at 400 kV, but actually operated at 300 kV, since no American sealed X-ray tube operates beyond this voltage. A general layout of the treatment department is given, the

apparatus for the excitation of high tension being situated outside the treatment room, which contains the protected X-ray tube only, and arrangements for treatment, *e.g.*, a couch, etc. No electrical details of construction are given and the remainder of the paper deals with biological details of erythema dose, filtration, etc., and the production of X-ray sickness. Whilst X-ray sickness has been reported to have vanished with the use of higher voltages, the author has found this is not the case at 300 kV, but, in general, considers a step forward has been attained by use of 300 kV and time will answer whether this is due to increased depth dosage, or biological effects dependent upon wave-length. B. J. L.

888. 700-kV Roentgen Therapy. R. E. Herendeen. *Am. J. of Roentgenology and Radium Therapy*, **34**. *pp.* 659–663, *Nov.*, 1935.—Discusses the clinical results, in cases of malignant disease, of X-ray therapy applied by a 900-kV X-ray installation in the New York Memorial Hospital, the results being of a purely medical nature. Whilst the apparatus can operate at 900 kV the treatments have been carried out mostly at 700 kV and 5 mA. B. J. L.

889. Distribution of Radiation Field in E.H.V. X-Ray Therapy. T. Leucutia and K. E. Corrigan. *Am. J. of Roentgenology and Radium Therapy*, 34. *pp.* 664–673; *Disc.*, 673–677, *Nov.*, 1935.—The distribution of intensity of X-rays, in respect to the tube focus depends upon a number of factors, but, in tubes operated at low or moderate voltages, is not of great importance. At high voltages, however, the variation may become of great importance in practical treatment. E.h.v. X-ray tubes may be classified in two groups, *i.e.*, the multisectional anode earthed X-ray tube due to Coolidge and the unisectional anode earthed or mid-earthed tube, sectional illustrations of the component parts of which are illustrated and described. In the latter class of tube, better to control the kathode ray emission and, therefore, the focal spot, the de Forest grid control, as used in thermionic valves, has been employed and the method by which the focal spot and focal emission is controlled is discussed in respect to photographs taken by the pin-hole camera method, isodosis curves, radiographs and actual areas of pigmentation on the human subject. It is shown that considerable spatial variation of intensity may occur, with astigmatism of the field of radiation. Methods to permit control of the radiation field are three, namely, the use of the pin-hole camera, ionometric mapping and photography of the field of radiation. The erythema production method cannot be used without risk to the patient prior to the purely physical methods. B. J. L.

***890. Precision Ionisation Chamber for X-Ray Dosage. A. Rogozinski.** *J. de Radiologie et d'Électrologie*, 19. *pp.* 693–699, *Dec.*, 1935.—Distortion effects upon the lines of force of the electric field in an ionisation chamber are discussed in relation to absolute determination of X-ray dosage. An ionisation chamber is described having plane and parallel electrodes to which guard electrodes are applied. One guard electrode is movable and can be adjusted to cover or uncover part or whole of an electrode used for actual measurement. It is demonstrated that, by this means, the value of the ionisation current via the field, is such as would be present with a perfectly homogeneous field and, as a result, the dosage can be exactly measured from a calibration curve expressing the ionisation current as a function of the length of the measuring electrode. The advantages of the instrument are elimination of all distortion effects

of the lines of force, with the possibility of great precision with a chamber of small size, to a degree impossible with the usual chamber, this benefit being especially marked with soft radiation. B. J. L.

891. Basis of Radium Emanation Therapy. S. Meyer. *Badgasteiner Badeblatt, No.* 9. [11 *pp.*], 1935.—An investigation is made of the physical processes involved in the use of free radon as a therapeutic agent. The emanation may be used in the form of an inhalent, as a drink, or in a bath. Curves are given showing the exhalation of radon after various periods of inhalation and after drinking solutions of the gas, both normal and pathological cases being shown. The effect of food on the retention and exhalation of Rn is described. In addition curves are given showing the absorption of emanation by the skin during and after radon baths. J. E. R.

892. Action of Radioactive Substances on Proteins. J. Loiseleur. *Comptes Rendus,* 201. *pp.* 1511–1513, *Dec.* 30, 1935.—Under the action of radioactive radiations, proteins become denatured and flocculent. The process is complex but experiments described show that it can be divided into two stages. The protein is first hydrolysed and then in the presence of a very dilute electrolyte it becomes flocculent. It is suggested that similar processes are involved in the biological action, *in vivo,* of the radiations. J. E. R.

893. Depth Dose in Radium Therapy. C. W. Wilson. *Brit. J. of Radiology,* 9. *pp.* 38–50, *Jan.,* 1936.—By means of measurements made with various wax phantoms, of the radiation intensities due to the two-gramme bomb at Westminster Hospital Annexe, a study is made of the relative magnitudes of the primary and secondary radiations comprising the total depth dose. It is shown that the intensity measured at a depth in wax is nearly always less than that measured at a corresponding position in air; therefore scatter does not compensate for absorption in this case. Even at depths as great as 10 cm. more than 80 % of the total dose consists of forward directed radiation of a quality that appears to differ very little from that of the primary radiation received by the skin. It is suggested that a small port of entry may be of value in the construction of a radium bomb if it is most desirable to use only the hardest radiations at a depth, since such an arrangement helps to reduce the amount of softer scattered radiation to a minimum. AUTHOR.

See also Abstract 725.

OSCILLATIONS.

***894. Negative-Resistance Oscillator. N. L. Yates-Fish.** *Phys. Soc., Proc.* 48. *pp.* 125–134, *Jan.* 1, 1936.—It is shown that an amplifier with its input and output terminals connected together can behave as a negative resistance. This principle leads to the design of an oscillator employing two triodes, and having certain advantages over both the ordinary reaction circuit and the screen-grid dynatron. Some special wave-forms which were observed are illustrated. A method of using the instrument to measure the dynamic resistance of an oscillatory circuit is suggested. [See also Abstract 2203 (1935).] AUTHOR.

***895. Controlled Oscillator for Generating Standard Audio-Frequencies. L. Essen.** *Journ. Sci. Instruments,* 13. *pp.* 9–13, *Jan.,* 1936.—A description is given of an audio-frequency oscillator which is controlled by a primary frequency of a constant value, and which provides

a series of discrete frequencies between 10 and 20,000 ~, the accuracy of which is better than 0·1 part in a million. The standard primary frequency used is 20,000 ~. It is multiplied to 80,000 ~. This frequency controls the audio-frequency oscillator, providing a series of values represented by $80{,}000/n$ ~, where n is any integer. When it is more convenient one of the series $40{,}000/n$, $20{,}000/n$ or $1000/n$ ~ is obtainable. AUTHOR.

896. Electron Currents. J. Müller. *Hochfrequenztechn. u. Elektroakustik*, **46**. *pp.* 145–157, *Nov.*, 1935.—An investigation is made of plane electron currents, assuming uniform velocities of the electrons, under the action of an oblique magnetic field and in the presence of a homogeneous distribution of ions of low mobility. The space-charge region is discussed and path times and current-potential characteristics are given. As regards small a.c. current variations the currents in an oblique magnetic field are found to have an a.c. resistance of the form $R=R_1 \cos^2 \phi + R_{11}\sin^2\phi$, where $(90°-\phi)$ is the angle between the magnetic field and the normal to the plane. R_1 and R_{11} are respectively the resistances for electron currents in a transverse or longitudinal magnetic field which give the same path times for the electrons from kathode to anode as for the currents in an oblique magnetic field. Discussion of R shows that oscillations of both the first and second kind may occur and that there is a continual transfer from one to the other. The case of the existence of a homogeneous distribution of ions of low mobility is dealt with by reference to the results previously obtained for a transverse magnetic field. The effect of velocity distribution is also discussed. [See also Abstracts **3946** (1934) and **505** (1935).] A. W.

See also Abstracts **851, 852.**

PHOTOELECTRICITY.

897. Effect of Oxygen upon the Photoelectric Thresholds of Metals. H. C. Rentschler and D. E. Henry. *J.O.S.A.* **26**. *pp.* 30–34, *Jan.*, 1936.—When a small amount of oxygen is allowed to react with an active surface of certain metals such as Th, U, Ca, Ba and Cs, the photoelectric threshold is shifted toward the longer wave-length. A similar reaction of oxygen with other metals such as Ti, Zr, Ag, Fe, Ni, etc., shifts the threshold toward shorter wave-length, while oxygen produces no effect on Au. The photoelectric work functions for the oxygen-treated surfaces of Th, U and Ca obtained agree with the thermionic work functions of W filaments containing oxides of these metals when activated. The experimental results indicate that the effects from these oxygen treated surfaces are due to the activity of the product of the interaction of oxygen with the metal and not due to a single atom layer of the metal on a base material. AUTHORS.

***898. Variations of Sensitivity of Rectifier Photo-Cells. E. Ferencz and J. Urbanek.** *Rev. d'Optique*, **14**. *pp.* 317–327, *Sept.*, 1935.—Observations are recorded showing the variation of sensitivity of rectifier cells with time of illumination, for white light and monochromatic light of various wave-lengths. An increase of output with time for low intensity is observed and attributed to a lag in the attainment of equilibrium, and under high illuminations fatigue is observed. The effects with red light are particularly noteworthy. An intense and prolonged illumination with white light produces a permanent change in spectral sensitivity, though

there is some recovery in the dark. Subjection to a temperature of 60° C. for several days produces similar effects. These results are discussed in relation to the selection and standardisation of these cells for photometric purposes. D. H. F.

***899. Sensitivity Compensator for Selenium-Sulphur Rectifier Photo-Cell. G. P. Barnard.** *Phys. Soc., Proc.* 48. *pp.* 153–162; *Disc.*, 162–163, *Jan.* 1, 1936.—The paper describes an investigation of the loss of sensitivity of the selenium-sulphur rectifier photo-cell with increasing obliquity of the incident light. When a restricted portion only of the surface of the cell is illuminated, it is found that the sensitivity increases as the centroid of the illuminated area is displaced from the centre of the cell. This permits of a simple method of compensation for the fall in sensitivity at oblique incidence, comprising the use of a central stop arranged at a suitable distance above the surface of the cell. AUTHOR.

***900. Becquerel Cells. G. Athanasiu.** *Ann. de Physique*, 4. *pp.* 377–449, *Nov.*, 1935.—The influence of the H^+ ions of the electrolyte is to tend to augment the photovoltaic effect, and that of the OH^- ions is to reduce and even to reverse it. The photovoltaic e.m.f. increases with decrease of temperature. Spectral sensitivity curves for a number of electrodes are given, and it is shown that in some electrodes the wave-length for the maximum effect is the same as that for the maximum photo-conductive effect for the same substance. One of the electrodes for which this occurs is Cu-Cu_2O, an electrode which is dealt with very fully and considered in its relation to the rectifier photo-cell. It is concluded that the Becquerel effect cannot be explained in terms of the external photo-electric effect, and that it is related rather to the phenomenon of photo-conductivity. D. H. F.

901. Becquerel Effect with Cu_2O Electrodes. A. Goldmann. *Acta Physicochimica*, 3. 2–3. *pp.* 303–334, 1935. *In German.*—By a consideration of the electrical properties of Cu_2O rectifier photo-cells and of photovoltaic electrolytic cells some new relations, which are the same for both devices, are derived. Similarly the properties of Cu_2O rectifiers and the polarisation of Cu_2O electrolytic cells are found to be covered by the same relations. The relations are shown to be in accordance with the experimental results recorded by other workers, and with experiments described in the paper. D. H. F.

902. Photoionisation in Gases. R. N. Varney and L. B. Loeb. *Phys. Rev.* 48. *pp.* 822–824, *Nov.* 15, 1935.—A balanced space charge ion-detector, previously described, is used to study photoionisation in gases. A hydrogen discharge tube with a fluorite window is used as a source of u.v. light. In the ion detector were N_2, A, Xe and air at 0·02 mm. Hg pressure, but the only ionisation observed is shown to be due to inefficient electrostatic shielding. In a further experiment electrons of energies up to 150 V ionise a gas at one end of a tube and the resulting radiation is allowed to fall on the same gas in an ion counter. Photoionisation is observed, but it can be stopped by inserting a fluorite window in the path of the radiation. It is shown that previously observed photoionisation cannot be due to the simultaneous absorption of two quanta. It is concluded that in pure, dry gases, photoionisation by radiation of energy materially less than the ionisation potential of the gas is highly improbable. J. E. R.

See also Abstract 691, 723, 838, 916.

PIEZOELECTRICITY.

903. Effect of X- and γ-Radiation on Piezoelectric Crystals. F. Seidl and E. Huber. *Zeits. f. Physik*, 97. 11–12. *pp.* 671–680, *Nov.* 25, 1935.—The electric conductivity and piezoelectric constant of Rochelle salt is measured before and after exposure to X- and γ-rays. The radiation produces a considerable increase in conductivity, but in general the piezoelectric constant is not appreciably altered. The piezoelectric constant of quartz is likewise unaffected by the rays. These results agree with accepted theories of crystal structure, according to which radiations can have a secondary influence only on the piezoelectric constant. γ-Rays impart a yellow coloration to Rochelle salt. P. V.

904. Longitudinal Vibrations of Right-Angled Quartz Plates. V. Petržilka. *Zeits. f. Physik*, 97. 7–8. *pp.* 436–454, *Oct.* 25, 1935.—Right-angled quartz plates cut perpendicular to the optic axis can exhibit three kinds of vibrations. Vibrations can be produced which proceed only in the direction of the one edge or in the direction of the other edge. Both kinds of vibration were found in agreement with the theoretical results. Deviations from theory are discussed. According to the theory of Lissütin vibrations can originate which simultaneously take place in the direction of both edges. This kind of vibration, at least its fundamental frequency, is also established. [See Abstract 3697 (1935).] J. J. S.

905. Elastic Oscillations of Quartz Plates Excited Piezoelectrically. R. Bechmann. *Zeits. f. techn. Physik*, 16. 12. *pp.* 525–528, 1935.—The elastic oscillations of quartz plates, the normals to which lie either in the XZ or the YZ plane, have previously been discussed [see Abstract 518 (1935)]. In the present paper calculations are made of the value of the modulus of elasticity and its temperature coefficient, also of the piezoelectric modulus, for four planes of section of the elasticity surface. It is found that for each direction there are three different velocities of propagation of elastic waves and in general also three possible elastic natural oscillations of thin plates, the natural oscillations and coupling coefficients being dependent on the direction of the wave normal, *i.e.*, on the orientation of the plate and the corresponding direction of oscillation. With regard to the temperature coefficient it is found that the elasticity surface of quartz has two curves along which the temperature coefficient of the modulus of elasticity is vanishingly small. A. W.

906. Interference Method for Measuring the Piezoelectric Moduli of Quartz. H. Osterberg and J. W. Cookson. *Rev. Sci. Instruments*, 6. *pp.* 347–356, *Nov.*, 1935.—The quartz plate is excited into forced sinusoidal vibrations by application of a 60 $\sim$ p.d. which can be increased gradually to 30 kV. The interference fringes between the end surface of the rod or plate and a slightly inclined stationary flat surface become blurred when the surface vibrates, and for a few easily calculated amplitudes the blurring is complete, *i.e.*, the illumination is uniform. Owing to the sensitiveness of the eye to uniform illumination, these amplitudes can be sharply identified, and by measuring the corresponding p.d. the moduli can be calculated. Measurements on suitably cut plates give $-6{\cdot}22 \times 10^{-8}$ cm./e.s.u. and $2{\cdot}24 \times 10^{-8}$ cm./e.s.u. for d_{11} and d_{14}. These values are in good agreement with those published by Pockels in 1893. P. V.

*907. **Wedge-Shaped Piezoelectric Resonators. A. Žáček and V. Petržílka.** *Hochfrequenztechn. u. Elektroakustik*, 46. *pp.* 157–159, *Nov.*, 1935.—The response curve of a wedge-shaped piezoelectric resonator is obtained by Dye's method. The resonator used tapered from 5·34 mm. to 5·26 mm. and had a natural frequency of 540·5 kc./sec. The response curve for this plate is found to resemble a normal, very narrow resonance curve, such as is given by a plane-parallel plate, much more than the curve for a band filter. The wedge-shaped form of the plate causes on the one hand a considerable increase of the damping and on the other hand gives rise to two, or sometimes many, crevasse curves lying very close together. A. W.

See also Abstract 421.

THERMIONICS.

908. Relation between the Emission Constants of Single Crystals and of Multicrystalline Material. A. Recknagel. *Zeits. f. Physik*, 98. 5–6. *pp.* 355–362, *Dec.* 23, 1935.—Under the assumption that the thermal emission of single crystals can be expressed by an equation of the Richardson type in which the constant A and the emission work w are dependent on the crystallographic orientation of the emitting surface, the corresponding constants A and w for multicrystalline material are calculated. The calculations are carried out for crystals of cubic and hexagonal (or tetragonal) holohedral structure. If for a single crystal A = const = 120 A/cm^2. deg^2. and w is variable, the value found for A for multicrystalline material is less than 120. When the difference in the work of emission (w) is a few tenths of an electron volt, it is found that for a fine crystalline material the value of A may fall to less than half that for single crystals. This opens up a possibility of reconciling the measured values of A, which for many pure metals are round about 60, with the theoretical value of 120. A. W.

909. Electron Emission and Conduction in Solid Bodies. A. Gehrts. *Zeits. f. techn. Physik*, 16. 11. *pp.* 370–373, 1935. *Phys. Zeits.* 36. *pp.* 764–767, *Dec.* 1, 1935.—For a monatomic layer of a foreign metal on another metal, such as Th on W the value of Richardson's constants A and b are less than the theoretical values but deviate little from those of a homogeneous kathode of the same material as the layer. The small deviations are therefore considered to be due to the film being monatomic and not to any relation between electron conduction and electron emission; hence no picture is obtained of electron phenomena inside the metal. H. M. B.

910. Electron Affinity of Iodine from Space-Charge Effects. G. Glockler and M. Calvin. *J. Chem. Phys.* 3. *pp.* 771–777, *Dec.*, 1935.—The electron affinity of iodine atoms has been determined by a direct method in which only iodine atoms and electrons were involved. The value so obtained is 74·6 k.cal., which is in good agreement with values obtained by other methods. The concentration of the several ions of different masses (I^- and E^-) have been calculated from their effect on space charge. It has been established that iodine has no effect on the thermionic emission of tungsten. [See also Abstract 929 (1935).] AUTHORS.

911. Surface Ionisation of Potassium on Tungsten. M. J. Copley and T. E. Phipps. *Phys. Rev.* 48. *pp.* 960–968, *Dec.* 15, 1935.—The surface ionisation of K on W is investigated by a method which

employs a ray of K atoms. The use of an atomic ray eliminates photo-electric currents and permits observations of the degree of ionisation to be made up to temperatures as high as 2800° K. Between temperatures of 1350° and 2170° K. the graph of the logarithm of the ion-atom ratio *versus* 1/T is linear, and when corrected to zero field yields a value of work function for W of $4{\cdot}51 \pm 0{\cdot}01$ V. The intercept on the $\log_{10} i_+/i_a$ axis has a value very near to zero instead of the value $\log_{10} 1/2$, expected from theory. This difference between the experimental and the theoretical intercept is interpreted as evidence for a temperature coefficient of the work function. If $\phi = \phi_0 + \alpha T$ expresses the temperature dependence of ϕ, α is calculated to have the value $5{\cdot}6 \times 10^{-5}$ volt degree^{-1}. It is suggested that the departure from linearity at high temperatures may be accounted for by assuming a temperature dependence in that range of the form $\phi = \phi_0 + \alpha T + \beta T^2$. AUTHORS.

912. Thermionic Emission from Tungsten and Thoriated Tungsten Filaments. W. B. Nottingham. *Phys. Rev.* 49. *pp.* 78–97, *Jan.* 1, 1936.—Investigations of electron emissions are made for applied fields from −7 to 1400 V, making a special study of zero fields. Filament potential is kept constant by an oscillating heating current from thyratrons. The energy distribution of electrons is found deficient in slow electrons, this is due to reflection effects and theories are considered to account for the reflection. The Richardson constant A indicates a negative temperature coefficient of the work function which is verified by an independent experiment. The new data in accelerating fields show large deviations from the Schottky mirror-image theory. A simple strip theory is substituted for Becker's patch theory which is not suitable for explaining the reflection effect since the latter is independent of the state of activation of the filament. H. M. B.

913. Emission of Positive Ions by Platinum when Heated in Oxygen. T. B. Rymer. *Roy. Soc., Proc.* 153A. *pp.* 422–442, *Jan.* 1, 1936.—The variation with temperature of the positive ion emission from Pt heated in O_2 is examined. The results are compared with the earlier work of Richardson and are discussed in the light of the Saha equation. Satisfactory agreement with the theory is obtained, but owing to the discontinuous nature of the emitting surface, it is necessary to assume a different value for the electronic work function from that determined experimentally. The difference is quantitatively accounted for. AUTHOR.

914. Shot Effect from Secondary Electron Currents. Lucy J. Hayner. *Physics*, 6. *pp.* 323–333, *Oct.*, 1935.—The shot effect of secondary electrons from the plates of triodes is measured at $10^5 \sim$ for five different triodes. The average number of secondaries for primary electron ranges from 1 to 4·5. Campbell's formulæ for shot effects of secondary emission plate currents are extended to grid currents, and from observed differences it is concluded that the secondary emission and primary impact are simultaneous within less than 10^{-6} sec. G. E. B.

See also Abstract 861.

THERMOELECTRICITY.

915. Electric Equilibrium and Permanent Thermoelectric Currents in a Metallic Circuit. F. Odone. *N. Cimento*, 12. *pp.* 522–530, *Aug.–Sept.–Oct.*, 1935.—The thermodynamic theory of phenomena

relating to electric equilibrium and the passage of permanent currents in a metallic conductor is considered. Using the idea of an electrochemical potential, a parameter introduced by Duhem to explain the action between electric charges and material masses, is shown the existence of a potential difference between the interior and the surface of a metal, of an internal and external Volta effect. The e.m.f. of a thermoelectric circuit and the coefficients of the Peltier and Thomson effects in terms of the e.m.f. of the thermocouple are calculated. It is found that the well-known theory due to Kelvin is based on contradictory hypotheses and cannot be accepted.

C. J. B. C.

916. Thermo-E.M.F., Peltier Effect and Photo-E.M.F., in System Cu-Cu_2O-Cu. G. Mönch. *Zeits. f. techn. Physik*, 16. 11. *pp.* 361–363, 1935. *Phys. Zeits.* 36. *pp.* 755–757, *Dec.* 1, 1935.—This paper gives experimental results and discusses them in relation to the theoretical elucidation of the effects mentioned in the title. D. H. F.

917. Thermoelectric Effects and Recent Electron Theory. M. Satô. *Tôhoku Univ., Sci. Reports*, 24. *pp.* 523–536, *Nov.*, 1935.—A theory of thermoelectric power, the Thomson and Peltier effects, based on Bloch's theory of electric and thermal conduction in metals, is developed and the results compared with those derived from Sommerfeld's theory. At comparatively high temperatures values of the respective coefficients so derived are three-times those derived from the application of Sommerfeld's theory. At low temperatures, values of the thermoelectric power agree in both theories. J. S. G. T.

918. Longitudinal Thermoelectric Effect. Part VI. Mercury. J. L. Ch'en and W. Band. *Phys. Soc., Proc.* 48. *pp.* 164–167, *Jan.* 1, 1936.—The Benedicks e.m.f. in mercury contained in an unconstricted glass tube is observed to undergo a reversible decrease with increasing temperatures. The result is in qualitative agreement with previous work [see Abstract 4422 (1935)]. It is suggested that there is an anisotropic quasicrystalline arrangement of the surface molecules of the mercury depending on temperature. Quantitative analysis of the temperature distribution failed to give the homogeneous coefficients, presumably because the effect of temperature on the constants is too marked.

AUTHORS.

See also Abstract 870.